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What We Don't Know About...

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Gravity
Earth's Core
Black Holes
Belly Button Lint
& Other Mysteries

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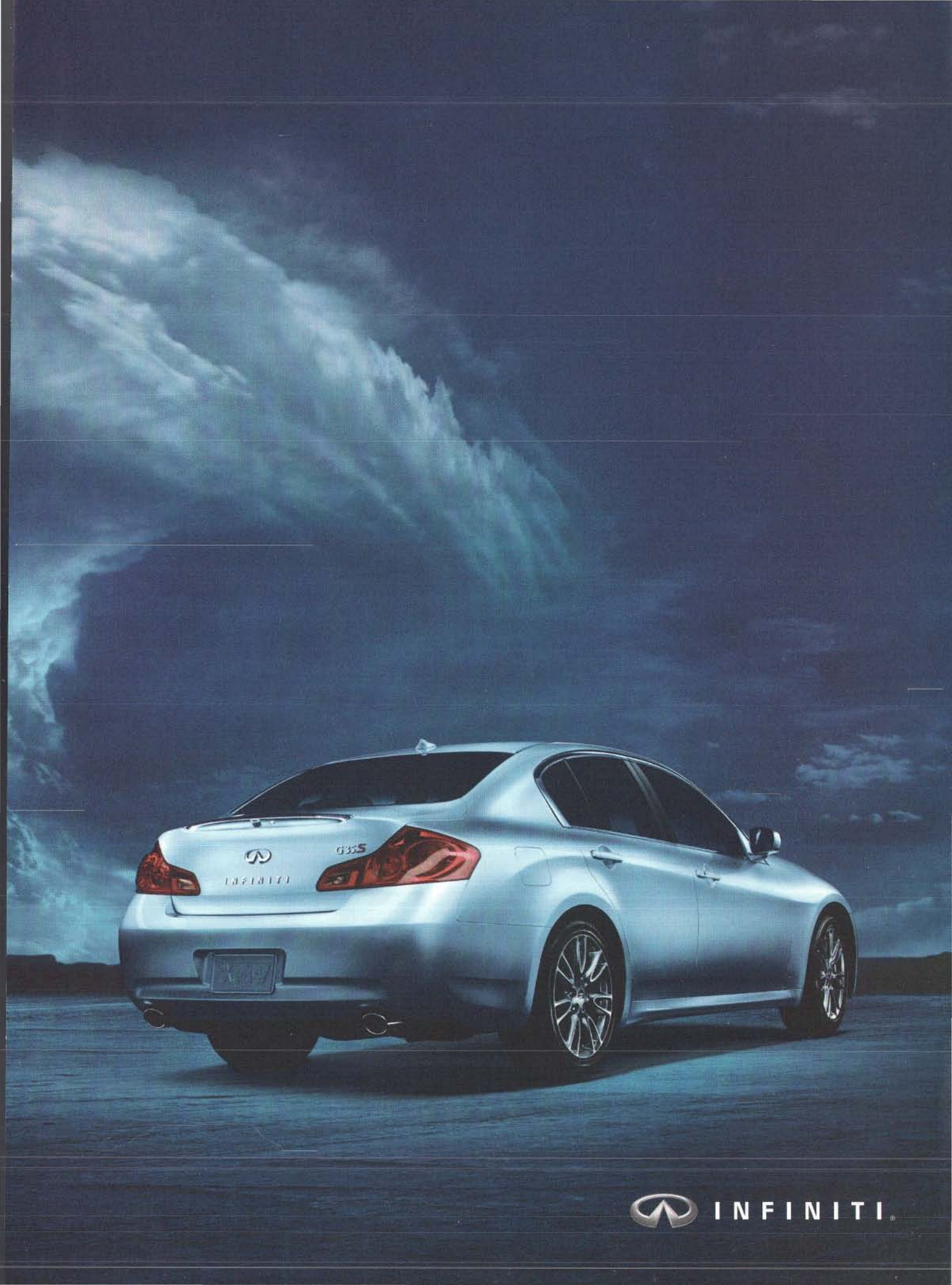
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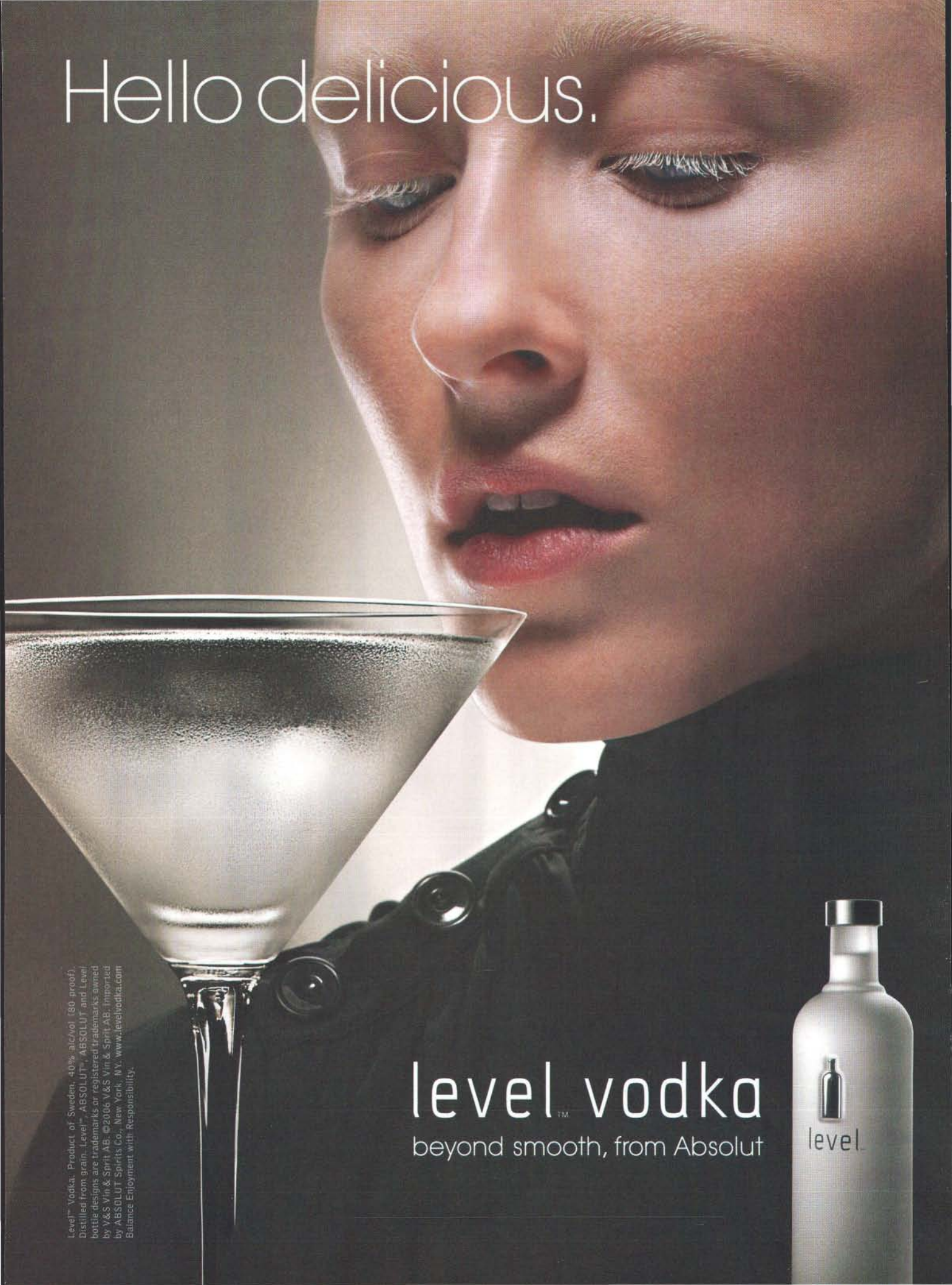
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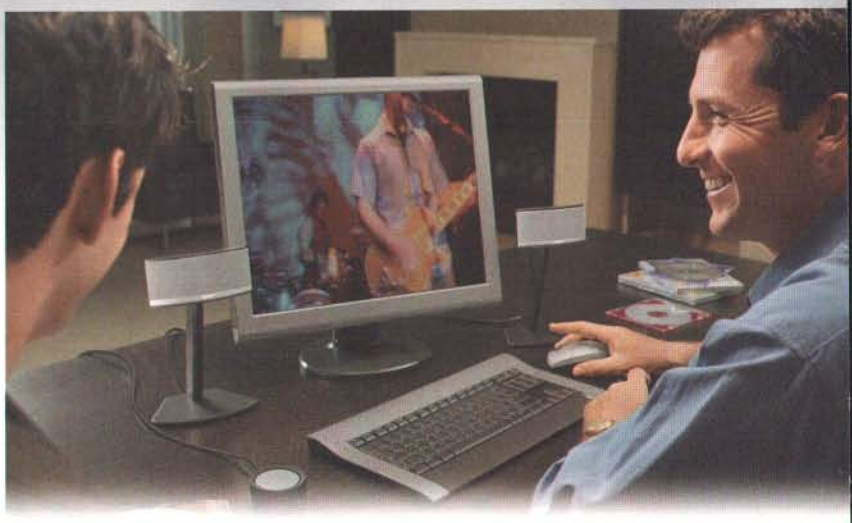
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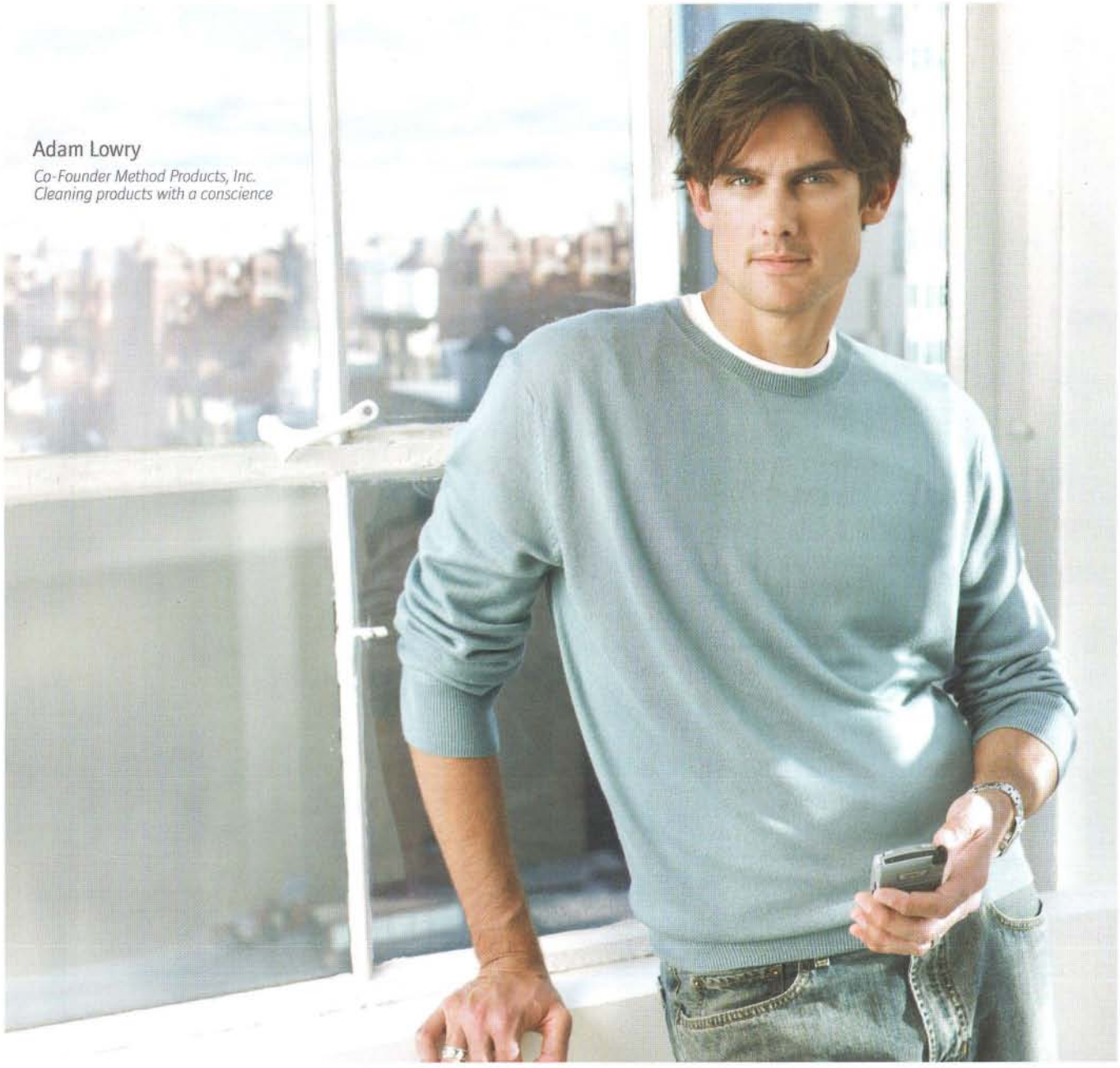
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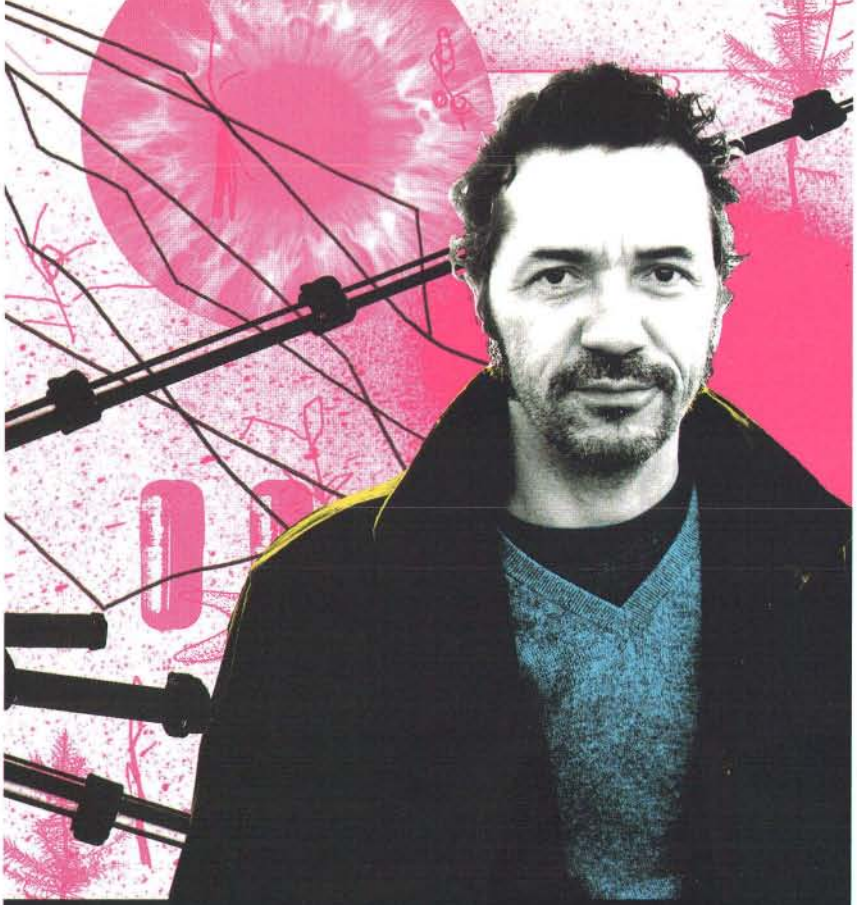
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"I always try to find something unsettling in my subjects, an element of ambivalence," says photographer **Tom Schierlitz**. This approach is evident in the conceptual portraits he created for our package on the unsolved mysteries of science (page 104). The elegant images illustrate the tension between what we know and what we wish we knew, the catalyst for all new discoveries.



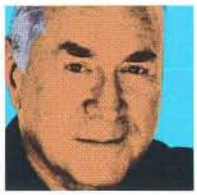
Brian Greene

Few people have done more than Greene to popularize physics in the past decade. His latest book, *The Fabric of the Cosmos*, was a best seller, and his recent *New York Times* editorials commemorated the 75th anniversary of Einstein's unified field theory. On page 113, Greene delves into the ultimate question: What is the universe actually made of? "By taking on the big stuff," he says, "we can get a better sense of how we all fit into the cosmos."



Natalie Angier

A Pulitzer Prize-winning science reporter, Angier studies what we know about Neanderthal economics to explore why our early cousins vanished (page 107). Modern man, she argues, could have used a little healthy competition. "Just as being the world's only superpower hasn't done much for the US or the world, our distinction as the only human species is of dubious value," Angier says. "The Neanderthals, alas, are long past caring."



Richard Rhodes

People have been pondering the mind/body duality and the nature of consciousness for millennia, but, as journalist and historian Rhodes writes on page 116, only recently have we been able to use technologies that can "see" the brain thinking about itself. "How consciousness develops relates to how we form our identities," he says. Rhodes won a Pulitzer Prize and National Book Award for *The Making of the Atomic Bomb*.



James Gleick

"Science is about knowing—and not knowing," Gleick says. "It's more important than ever that we remember that." The journalist and essayist is writing a book on the history of information theory, and on page 121 he examines nature's basic building blocks: atoms and bits. While answers may prove elusive, he says, "the scientific enterprise is still the best way we have of finding out about the world. It's also the one that never forgets its limits."

ILLUSTRATION BY **Christopher Sleboda**

ANGIER: DARRYL ESTRINE

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My name ..... ELLEN DEGENERES .....

childhood ambition ..... TO WORK WITH ANIMALS .....

fondest memory ..... I CAN'T RECALL, BUT I'M SURE I'M FOND OF IT.

indulgence ..... DOING NOTHING .....

last purchase ..... BUTTER .....

favorite movie ..... WORLD ACCORDING TO GARP + OUT OF AFRICA .....

inspiration ..... KINDNESS .....

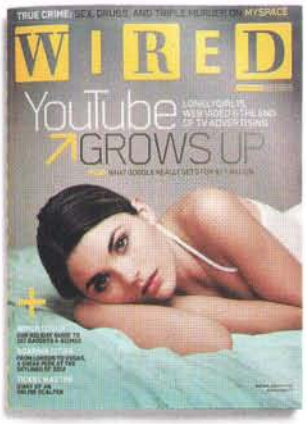
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RE: Drugs & Lonelygirls

NEXT TIME READERS COME TO DINNER, we're hiding the silver. Scofflaws and bandits, all of you! Our story about Indian drug company Cipla in the December issue elicited tales of the shady work-arounds you'd perpetrated to snag cheap generics. Likewise, in response to "Diary of a Scalper," we got letters describing how to game the online ticket-reselling biz. Let's just say your methods involve human mules and pseudo-normal browsing-pattern simulations. To balance out the negative karma, though, one Goody Two-Shoes suggested we donate our scalping proceeds to a homeless shelter. No way! We need the dough to buy meds from India. Oh, and to the guy who thought that the Lonelygirl15 "happening" was swiped from William Gibson's *Pattern Recognition*: Hardly, but even if it was, hey, the world is full of thieves.

EDITORIAL CORRESPONDENCE **chat@wired.com**

Not Ready for Prime Time

"You Tube vs. Boob Tube" (issue 14.12) was fascinating, but I question the assumption that YouTube competes with (and may someday replace) traditional network broadcasting.

The two coexist and likely will for some time. The reason is simple: video image quality. Jerky, low-resolution video is fine for watching two-minute clips of treadmill dancers and dozing cats. But no one would want to watch a half hour of anything in that format—certainly not a two-hour movie.

Our current broadcast standard isn't exactly high-fidelity. But its image quality is orders of magnitude beyond that provided by YouTube. Until this fundamental deficit is remedied, and so long as there are people out there who want to watch something other than short video clips, the traditional broadcasting format will stay with us.

David Eide
HOMER GLEN, ILLINOIS

"The Secret World of Lonelygirl" broke the heart of every Internet geek. There truly is no hope now.

Dimitri Papad
FORT LAUDERDALE, FLORIDA

Hit the Spot

Lonelygirl15 is "a new kind of storytelling" ("The Secret World of Lonelygirl," issue 14.12)? I guess, if you can call an idea that first emerged over a decade ago "new." What about the original "is it real?" Web content, The Spot, which had fans wondering if it was fictional? The site's visitors could exchange messages with the show's characters, and their input would affect plot development. The entire experience was designed to seem real.

If Lonelygirl15 wants to see where she's headed, she needs only to find an archive of The Spot Web site.

Peter Duniho
KIRKLAND, WASHINGTON

New Media, Same Old Story

The founders of YouTube put together a site that collects free content (tons of it illegal), then walk away with $1.65 billion. Meanwhile, the producers of Lonelygirl15 borrow money from their parents, and Lonelygirl herself is thrilled to get $500 a week as a "working actress." ("You Tube vs. Boob Tube," and "The Secret World of Lonelygirl," issue 14.12.) It's great to see that the "new media" treats the creative talent so much better than the old one did .

There are plenty of boobs around this tube: the creative people donating their talents to this insane system, the creeps who illegally post others' work, and the greedy geeks claiming "we can't control what people do on our site." I hope you enjoy your two-minute Lonelygirl clips—for what the Internet pays for creative, that is as good as it will get.

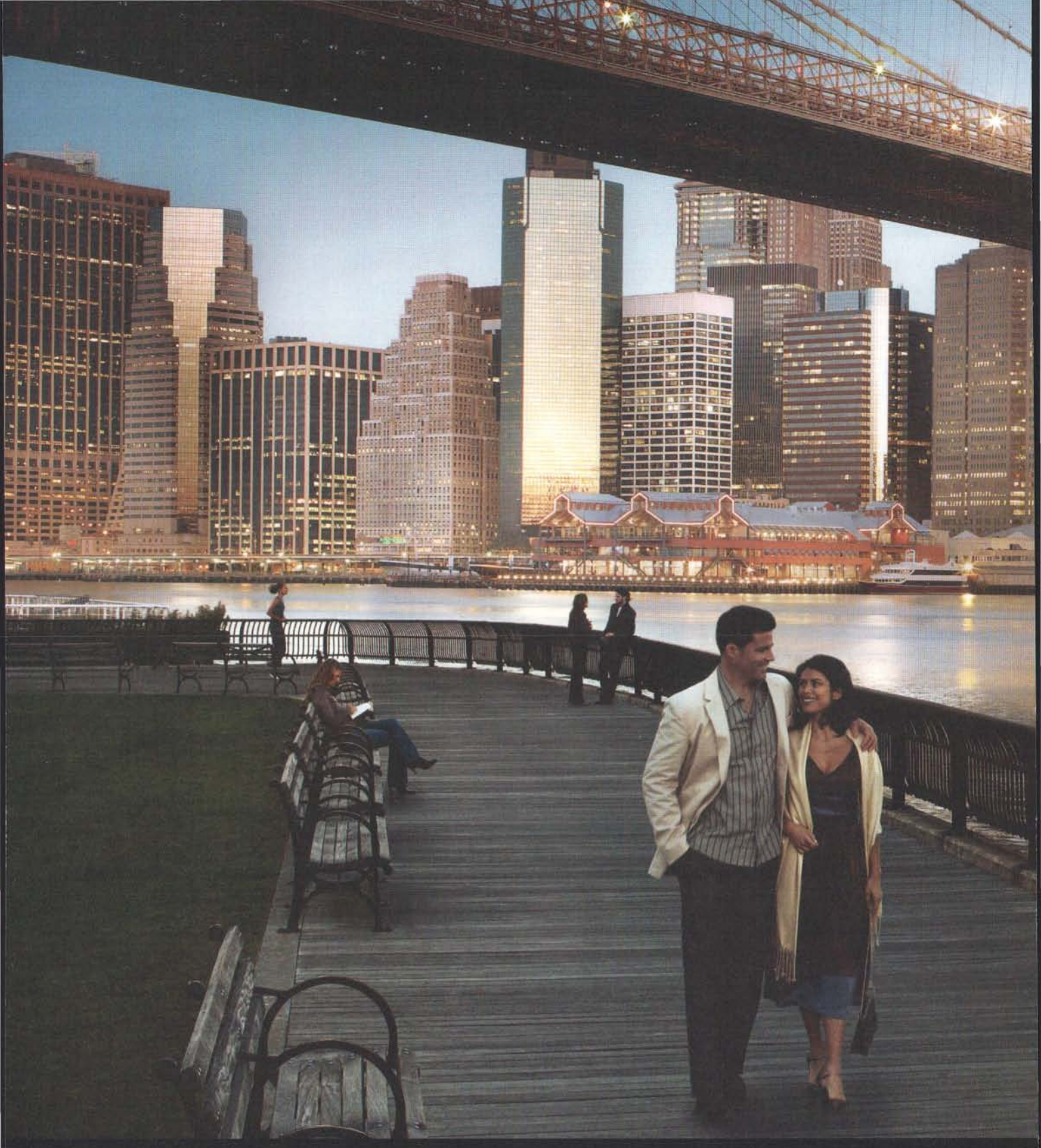
Mark Easley Sr.
MORRISVILLE, NORTH CAROLINA

CHAT

No Admittance

This kind of crap—online scalping—is precisely why I prefer to watch sports events and concerts on high-definition television ("Diary of a Scalper," issue 14.12). Unless they want to pay tons of money, true fans have no chance against these pros for decent seats anymore. Even if Jimi Hendrix came back from the dead, I wouldn't pay $500 to see him.

William Jeffrey Jones
LADERA RANCH, CALIFORNIA



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Props to Uwe Boll for rolling around in his own failures and making something worthwhile. It was like *Celebrity Deathmatch* without the celebrities.

Paul Escobar
BURBANK, CALIFORNIA

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Blame the Victim

The idea of a person's virtual life extending beyond their physical life is interesting, but the way you portrayed the characters involved in the murder was abhorrent ("Murder on MySpace," issue 14.12). You vilified Ulysses Handy III, painting him in a negative light for his past deeds, but glossed over the fact that Darren Christian made his money dealing ecstasy, a drug with devastating side effects that can include death. It is a tragedy when anybody dies young, especially under violent circumstances, but the article maligns one killer while exalting another. And is the reader actually expected to feel sympathy for Ashley Foley, who, upon the capture of her boyfriend's suspected killer, posted a message that attacked not Handy's character but his race? I doubt you would speak so highly of a person like Christian or anybody who would use a racial slur in a hateful manner were it not for the tragedy that surrounds them. You failed to avoid a pitfall of the thoughtless—exalting the dead without reason.

Colin Dillon
NEW YORK, NEW YORK

Ain't No Saint

Don't try to make a drug-using, fast-driving, bad-influence-having bad seed out to be a saint ("Murder on MySpace," issue 14.12). It makes you look like a bunch of bleeding heart assholes.

Nathan A. Ingold
DANVILLE, ILLINOIS

Knockout Picture

Uwe Boll challenged his critics to a boxing match ("Raging Boll," issue 14.12). It would've been more interesting if he had challenged his critics to a collaboration, spent months working with them on a screenplay, and then produced a good movie.

Steven McDougall
LITTLETON, MASSACHUSETTS

Meter Reader

Yes, I am interested in how long the coolest supertanker is. Yes, I want to know the precise diameter of that latest kick-ass telescope, and *no*, I do not have a clue how to convert feet and inches to the metric scale. WIRED, you have a fan base outside the US; won't you please do us a favor and put your measurements (even if it's in brackets) in a universally understandable format? I know you're not trying to land a Mars rover, but sticking to feet and inches is like sticking to creationism.

Erich Hugo
STOCKHOLM, SWEDEN

Structural Faults

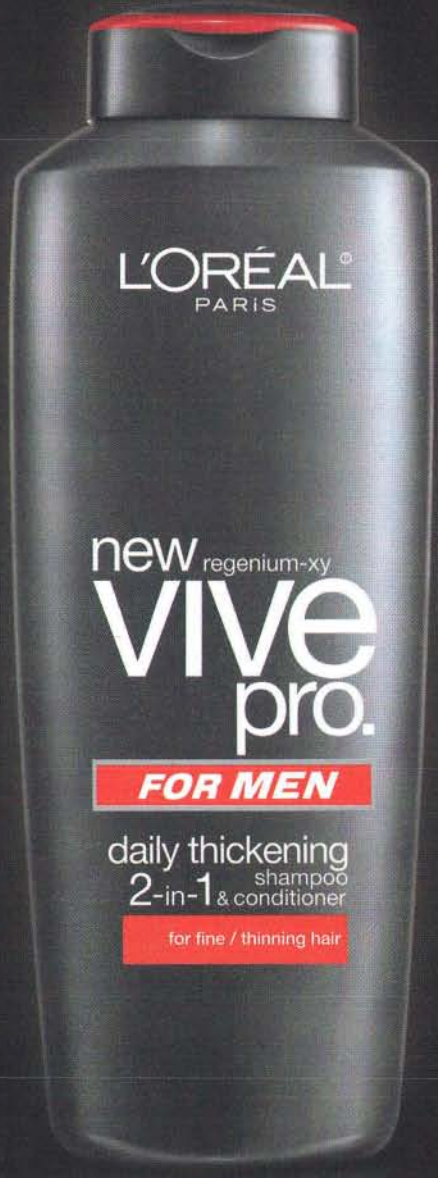
Thanks for the architectural update: tall buildings and twisted buildings (Start, "Manhattan Projects," and "Edifice, Complex," issue 14.12). These inventive genres are made possible by architectural software, and the story behind each of your stories is the painfully slow development of 3-D software applications for the building industry, which desperately needs the technology. Why did Permasteelisa have to use aircraft software to do the job?

Jim McDonald
MCLEAN, VIRGINIA

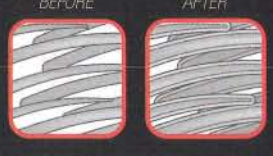
UNDO Richard Feynmann was a physicist, not an astrophysicist ("The Secret World of Lonelygirl," issue 14.12). Two hundred microns per second equals 0.000447, not 0.5, miles per hour (Start, "Will Work for Food," issue 14.12). A line pointing to Chad should have been directed at Niger in "The Population Dilemma" (Start, Atlas, issue 14.12). Thomas Pynchon's *Against the Day* is 1,085 pages, not 1,120 (Play, Reviews, issue 14.12). **CHAT** Letters should include writer's name, address, and daytime phone number and be sent to *chat@wired.com*. Submissions may be edited and may be published or used in any medium. They become the property of WIRED and will not be returned.

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*Consumer perception among men who saw a thickening effect using shampoo and a gel.

Return to Sender

See page 156 for contest rules.



The Long Tail,
BY JON AND JAY MARSTERS

You Get What You Pay For

Kris Wagner's article on gadgets that barely outlive their warranties completely ignores the Wal-Mart effect: the constant downward pressure on price ("Built to Fail," Wired Test 2007). Product design is a difficult balance of cost and durability. You can have a cell phone that lasts 10 years if you're willing to pay the price. There's nothing diabolical in electronic devices barely outlasting their warranties. It's just a reflection of our own unwillingness to pay for quality.

Steve Lance
NEW YORK, NEW YORK

Art of Persuasion

Thirty minutes after reading "Paint by Numbers" (Posts, issue 14.12), I was on the site, typing in my PayPal information to buy *519*—my hometown area code.

Thanks heaps for helping me waste/invest hundreds of hard-earned dollars in seconds flat. I've never enjoyed blowing my money so much before.

Dan Rollman
SAN FRANCISCO, CALIFORNIA

Interpretive Dance

I was underwhelmed by "Me Translate Pretty One Day" (issue 14.12). The easiest language pair for a machine to translate is Spanish-English. Why? Because Spanish is highly inflected (giving the computer clues), very regular (even its irregularities are easy to spot), and very structured. English, as the target language, is not highly inflected (the machine does not have to worry about case, gender, number, et cetera), but is very flexible (something out of order will be less of a problem than in other languages). Also, the sentence you used as an example is written in standard journalistic Spanish, which has syntax that's very similar to English. It even uses an anglicism—*justo*—to make it easier.

I have worked in translation for 35 years and have used at least 50 machine translation systems and, while it was fun and useful on occasion, there is no way now or in the foreseeable future that machines can even come close to humans for standard texts. Just ask the system in the story to translate "Time flies like an arrow" into French.

John Alvey
ANNANDALE, VIRGINIA



Change Is Good

REDESIGNING A MAGAZINE IS LIKE upgrading your OS—change is good, but you still want the thing to be familiar. That's the spirit behind the new look we debut this month. Spearheaded by creative director Scott Dadich, who joined WIRED last spring from *Texas Monthly,* the redesign is based on a simple premise: expand our use of provocative photography and inventive illustration while maintaining our tradition of innovative typography and design pioneered by John Plunkett in 1993.

Leaf through these pages and you'll see evidence of Scott's handiwork. The building blocks of the magazine are four new families of type designed by Hoefler & Frere-Jones, the preeminent typography studio in the US. In the front of the magazine, there's a makeover for Start, Posts, and Play—not to mention this section, newly christened Chat (formerly Rants+Raves). We even moved to a thicker, less glossy paper, which shows off our photography and makes the magazine easier to read. And then there's the tweak to our logo. Can you spot the difference? Hint: It now obeys the Law of Optical Volumes.

What hasn't changed, of course, is our commitment to delivering big ideas and exploring the impact of technology on everyday life. To do that, we rely on great stories, great writing—and great design. We'll continue fine-tuning the look of the magazine in the months to come, and wired.com will get a complete overhaul in early spring. Contact us at *chat@wired.com* and let us know what you think.

—THE EDITORS

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SINGLE MALT SCOTCH WHISKY

12

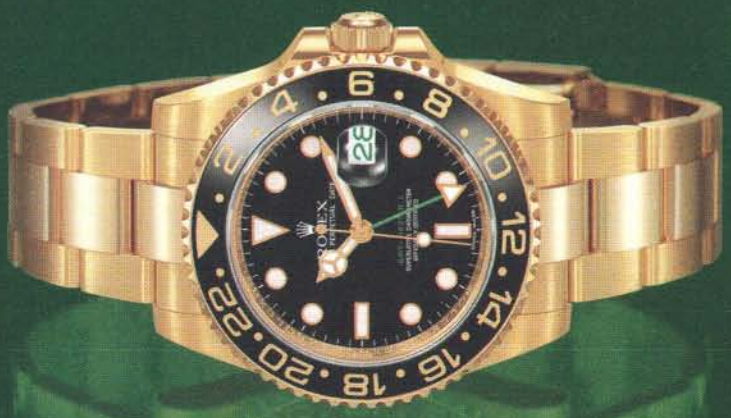


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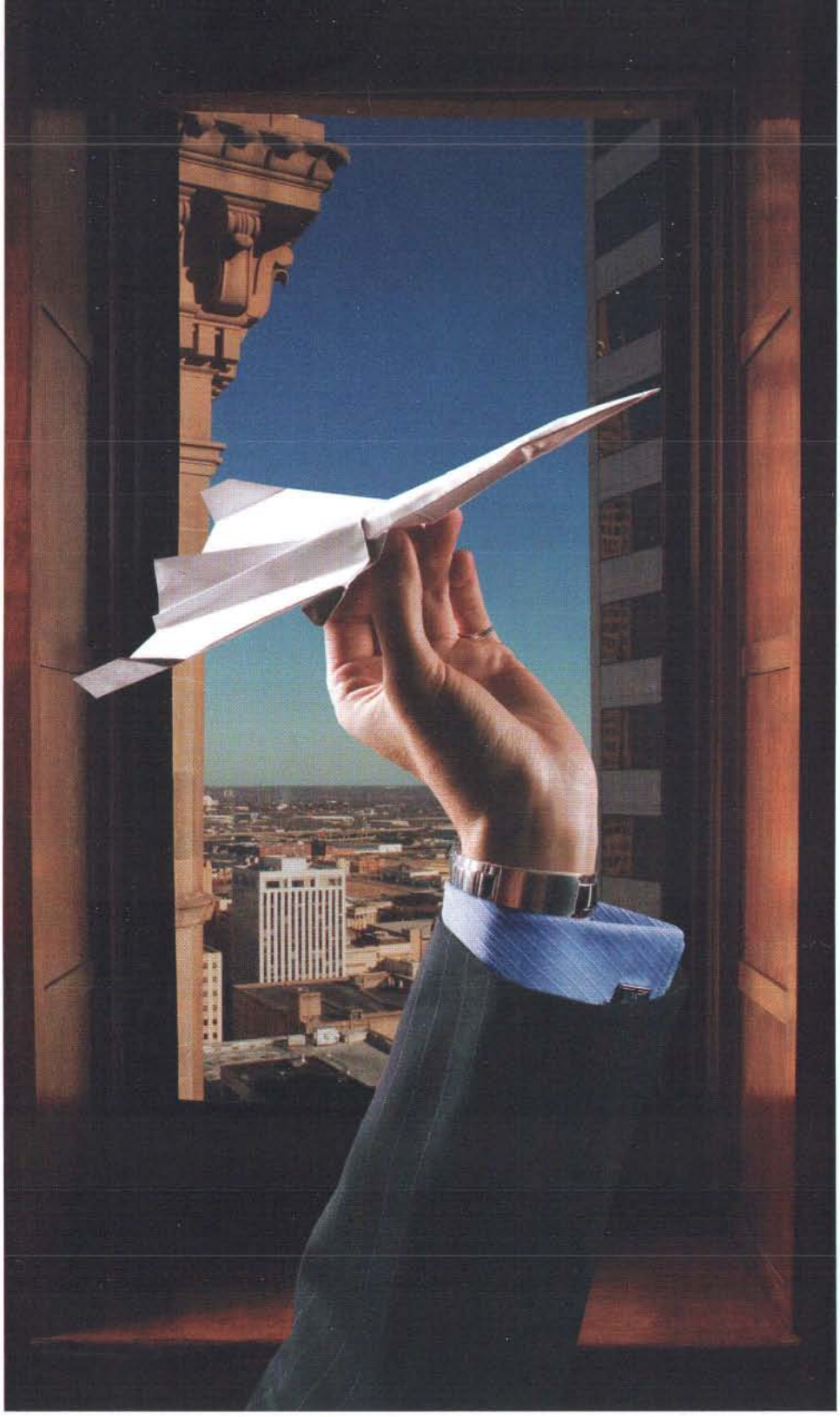


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Flights of Fancy

Supersonic passenger jets are back—billionaires board first. by Daniel Gross

CONVENTIONAL wisdom holds that the horrific crash of the Concorde in 2000 along with the post-9/11 aviation slump finally grounded the world's only supersonic passenger jet for good. But as a business, the Concorde never really took off. A limited-run product of state-controlled manufacturers (Aerospatiale and British Aircraft Corporation), the Concorde was sold to then-state-controlled airlines (British Airways and Air France), which viewed the plane as a loss leader. The Mach 2 bird was good for branding, but window-rattling sonic booms confined it to traveling over oceans, and coaxing 100 passengers to fill the narrow seats at full fare proved impossible

Despite this precedent (and half a dozen even less successful attempts to put supersonic passenger jets into service), two US companies now think they can make high-speed flight commercially viable. The trick, it seems, »

is to focus on the richest of the rich. Supersonic Aerospace International, founded by J. Michael Paulson, son of Gulfstream founder Allen E. Paulson, has hired Lockheed Martin's Skunk Works to design a 12-seat private jet shaped to minimize sonic booms. Projected development cost: $2.5 billion. Meanwhile, Aerion, backed by the Bass family of Texas, is spending roughly $2 billion to build a fast (Mach 1.6) 12-seater that will likewise comply with noise regulations. The planes could begin boarding as early as 2013 and 2012, respectively.

Two US companies now think they can make supersonic flight a commercially viable business. The trick? Focus on the richest of the rich.

It's easy to bet that neither effort will succeed. What makes these startups think they can turn supersonic flight into a profitable business in just a few years when *countries* have tried and failed to do so for decades? It's also easy to be cynical about the attempt. Why waste resources on really fast jets to shuttle CEOs between far-flung vacation homes? But both businesses just might work, and you should cheer them on. They may be the best chance we have of seeing commercial supersonic travel return in our lifetime.

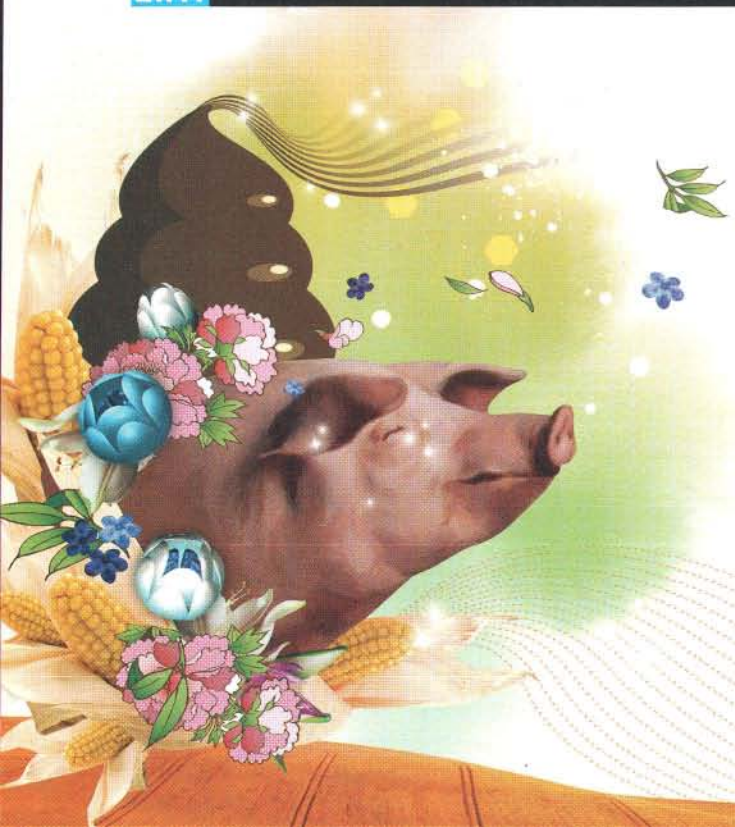
The business case for the planes presumes sales of 300 such jets over 10 years at $80 million each—a $24 billion market. Analysts say that, given recent trends, such assumptions aren't unreasonable. The private-jet business has risen from $3 billion in deliveries in 1996 to about $16 billion in 2006 (bigger than the market for fighter planes). Boeing and Airbus each produce about 10 luxury jets for private use annually, which sell for $45 million to $60 million apiece, while Gulfstream produces 30 to 35 planes a year that go for $45 million or more a pop.

Yes, the market needs to grow to meet SAI and Aerion's expectations. But it does seem that selling a handful of seats to the filthy rich might be more economically feasible than selling hundreds of seats to the merely rich. And it will be far better to have supersonic travel in the hands of nimble, bottom-line driven companies than sclerotic, state-backed behemoths. Remember, most leaps in communications and transportation technology started as a tools for the ultrawealthy. Sending data on the first transatlantic telegraph cable cost $10 a word—in 1866. Twenty years later, telegraphic services were widely available to owners of small businesses. Henry Ford's Model A listed for $850 in 1903. By the 1920s, the Model T went for about $265 and could be bought on credit. When it comes to technology, trickle-down theory actually does apply.

Still, only competition can start that trickle flowing, and private supersonic aviation won't get really interesting until there are 15 greedy entrepreneurs buzzing around that $24 billion market. We need a few ambitious investors to fund supersonic plane production on par with how Union Pacific, Northern Pacific, and Atchison, Topeka & Santa Fe laid tracks in the 19th century or how Global Crossing, Worldcom, and others threaded fiber-optic cables in the 1990s.

Many of these enterprises would fail. But in the process, they'd drive prices lower, develop products and services quickly, and gain economies of scale. Then, and only then, would risk-averse pterodactyls like Boeing and Airbus be willing to take another swing at jetting you from New York to LA in two and a half hours.

DANIEL GROSS (moneybox@slate.com) *wrote about Philip Rosedale in issue 14.06.*



Welcome to BioTown, USA

Two years ago, Reynolds, Indiana (pop. 547), was slowly dying. So governor Mitch Daniels hatched a plan: Rechristen Reynolds as BioTown, USA. The project aims to transform the burg into a showcase of the state's eco-potential, with home-brewed ethanol and biodiesel for cars, electricity generated from cornstalks and soybean stubble, and methane gas derived from manure—hog and human. Of course, Daniels isn't the first official to see lush economic pastures in small-town green energy: A new business park in Medway, Maine, plans to use biomass from the region's forests to run a hyperefficient electric plant, and the beleaguered lumber town of Aberdeen, Washington, is constructing a biodiesel plant. But when the optimism clears, will these well-intentioned efforts be sustainable? In Reynolds, the local gas station owner had to sell to an outside investor because he couldn't afford to install an ethanol tank to serve the town's 171 new flex-fuel vehicles. And in Carthage, Missouri, a facility that produces biodiesel from turkey carcasses has been shut down repeatedly because of its nauseating odor. "It's a great idea," says a town resident. "I just wish it was somewhere else." —LISA MARGONELLI

ILLUSTRATION BY Oksana Badrak

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■ **TETRAFLUOROETHANE**
A type of fluorocarbon that doesn't deplete the ozone layer, TFE is found in everything from cryogenic-tissue kits to car air conditioners. Here it's used as a tire inflator, a drying agent, and a propellant for the other ingredients. Unfortunately, it's also a greenhouse gas that's been implicated in abnormal testicular growth in rats—you must have some serious cojones to keep using it.

■ **HEAVY AROMATIC SOLVENT NAPHTHA**
It's not called aromatic because it smells (though it does—like petroleum). *Aromatic* is a scientific term referring to any molecule with one or more hexagonal rings of six carbon atoms. They can be unusually stable and powerful solvents for other hydrocarbons. Since naphtha is a mixture of medium-weight aromatic rings in the C9-to-C16 range (extra carbon atoms can hang off the sides of the main structure), it easily dissolves smaller carbon compounds like simple plastics but won't harm larger polymers like styrene-butadiene (synthetic tire rubber).

■ **AROMATIC RESIN**
Aromatic hydrocarbon wwwwresins are sticky substances made almost exclusively of C9 monomers (small molecules that can join with other molecules to form polymers). They are commonly used as epoxies and adhesives and, like naphtha and amorphous polyolefins (below), they are found in partially distilled crude oil. Usually all these substances would be further processed and separated, but keeping the resins, naphtha, and polyolefin together works like magic here. How so? Read on.

■ **AMORPHOUS POLYOLEFIN**
In the can, this shapeless mass of polymeric olefins (low-density plastics like polypropylene and polyethylene) remains dissolved in the heavy aromatic naphtha. But once Fix-a-Flat is sprayed into the tire, the plastics coat the inner surface and plug the leak. Then the sticky aromatic resins keep them in place. The TFE dries the resins and polyolefins, and you drive to the nearest service station to get your tire repaired.
—PATRICK DI JUSTO

PHOTOGRAPH BY Thomas Hannich

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Queen Amidala's royal gowns
STAR WARS: EPISODES I, II & III
Stitch together all the scenes in which Amidala wears vaguely Japanese haute couture and you get a new edit: *Star Wars: Episode III.I—Memoirs of a Padmé.*

Khan's suede vest
STAR TREK II: THE WRATH OF KHAN
Mr. Roarke trades his white suit for a dingy suede wrap-around number and brings Kirk's worst nightmares to life. Nothing says wrath like man-cleavage. Well, that and a stellar mullet.

Aunty Entity's chain mail dress
MAD MAX BEYOND THUNDERDOME
It takes a strong woman to pull off this frock. Really—it weighs like 70 pounds. Hey, Tina Turner *was* pretty buff in *What's Love Got to Do With It?* Oh wait, that was Angela Bassett. Still ...

Kyle Reese's trench coat and Nikes
THE TERMINATOR
Michael Biehn's pilfered outfit influenced costume design from *Highlander* to *The Matrix.* Sure, he steals pants from a homeless guy, but that just boosts his street cred.

Feyd-Rautha's winged Speedo
DUNE
When Sting's character appears wearing nothing but a blue art deco-style Speedo barely big enough to cover his stinger, the Baron Harkonnen isn't the only one mesmerized.

The Predator's bodysuit
PREDATOR
He may sport an effete fishnet body stocking beneath his hunter accoutrements (seriously—look closely), but the Predator still picks off Ahnuld's entire entourage. Who's the girly man now?

Morpheus' sunglasses
THE MATRIX
Laurence Fishburne's awesome clip-ons snap to his nose and are so reflective that you can actually register Keanu's envy in closeups. "Dude, my shades are totally bogus."

Princess Leia's slave girl costume
STAR WARS: EPISODE VI—RETURN OF THE JEDI
Looks like Princess Leia's been hitting the gym since *Empire.* While not ideal for swimming, her metal two-piece is perfect for lounging by the Rancor Pit.

Zhora's peekaboo raincoat
BLADE RUNNER
Every stripper knows that clear gets you noticed, so it's no surprise Zhora's see-through raincoat doesn't help her flee Deckard. She gives a whole new meaning to the term *fashion victim.*

Barbarella's white go-go boots
BARBARELLA
Before Jane taught us how to work out, she showed us how to work it in thigh-high boots. If only space were filled with randy go-gonauts, pointless sexual adventures, and erotic torture devices. Feel the burn.
—JAY RUBEN DAYRIT

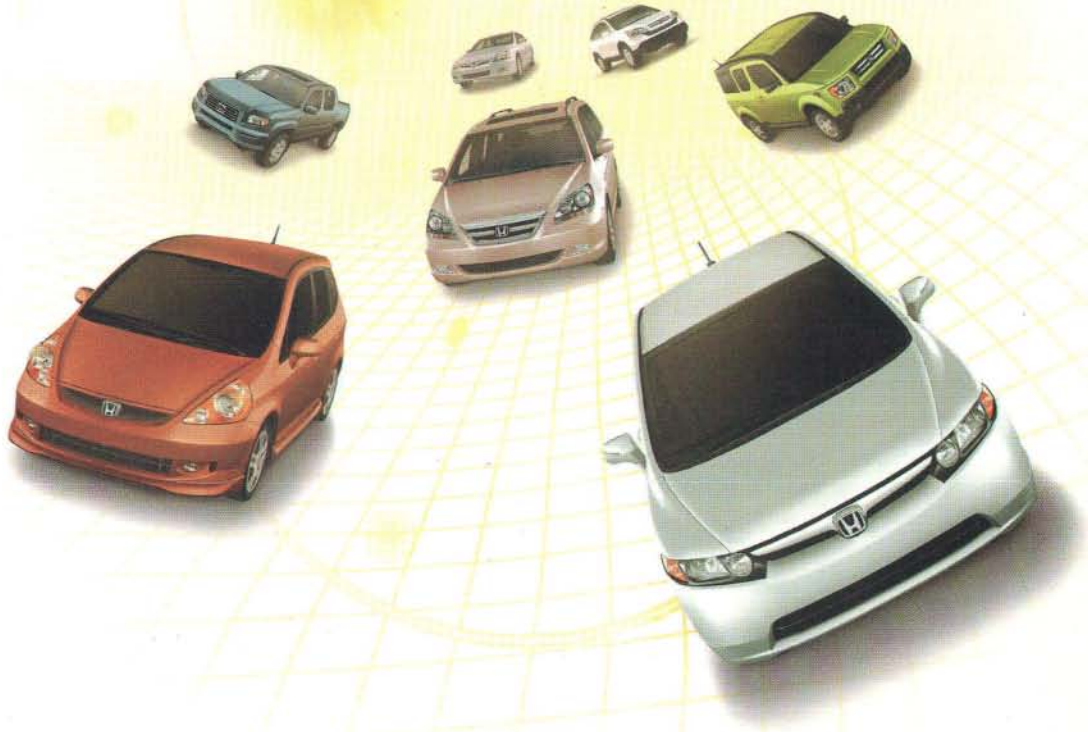
WTF? Ancient Diseases, Reborn

Scientists in France are resurrecting ancient human retroviruses, HIV-like bugs that attacked our ancestors millions of years ago and remain fragmented in our DNA. The team has reconstructed one, dubbed Phoenix, that could again infect human cells. Michael Crichton, your next book is writing itself. —ARIA PEARSON

DNA: BOB HAMBLY

ILLUSTRATION BY **Dermot Power**

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Meet Small Oil. Honda has always been committed to developing environmentally responsible technology. And with cars like the all-new Fit along with the legendary Civic, Honda will continue as the leader in fuel efficiency.† Through innovation and hard work, Small Oil can make a world of difference. That's our Environmentology.™

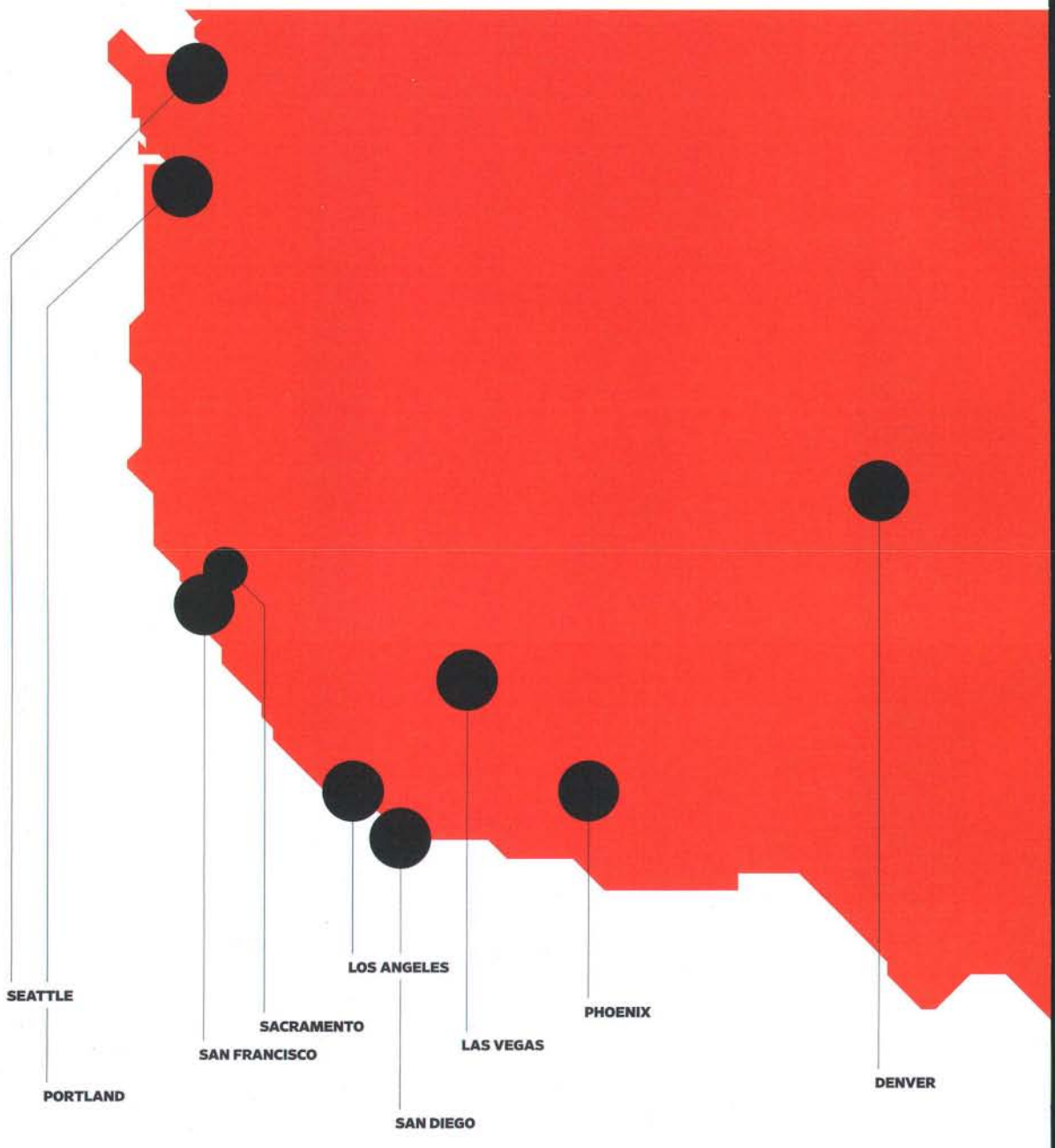
HONDA

The Power of Dreams

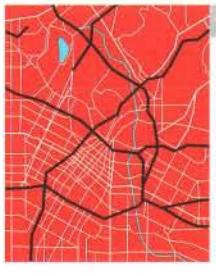
*Based on model year 2005 CAFE average fuel-economy ratings and weighted sales for passenger-car and light-truck fleets sold in the U.S. by major manufacturers. †Civic Hybrid and Fit Sport with 5MT shown. 2007 EPA mileage estimates: 49 city/51 highway, 33 city/38 highway, respectively. Use for comparison purposes only. Actual mileage may vary. ©2006 American Honda Motor Co., Inc. environmentology.honda.com

In Case of Emergency, Pray

Most US cities are ill-equipped to handle a mass evacuation.



The lesson of New Orleans is clear: When disaster strikes, you're on your own. If the Big One shakes St. Louis or a dirty bomb blows up in Atlanta, residents and tourists alike will have to get themselves out of Dodge as best they can. Not that it'll be easy. Geographic barriers restrict some evacuation routes, and many highway systems aren't equipped to handle a major load. A new report from the American Highway Users Alliance evaluated the emergency exit capacity of 37 major US cities, half of which got a failing grade. Here's a look at the best—and worst—places to flee when the sirens begin to wail. —PATRICK DI JUSTO

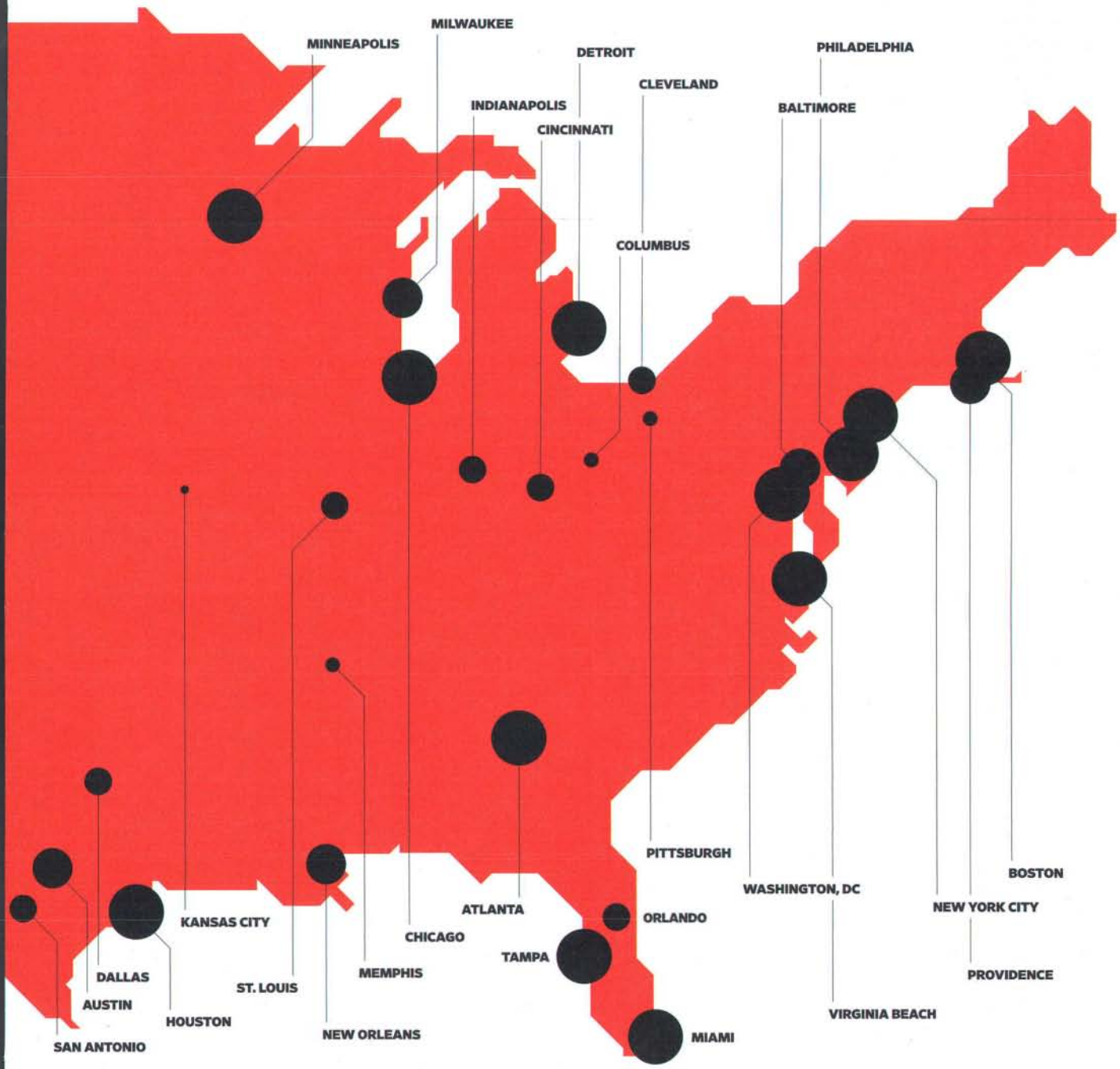


LOS ANGELES

Almost all Angelenos have cars, and they're going to use them. The problem? They won't get anywhere. Imagine the worst SoCal rush hour—but with drivers fueled by Red Bull *and* panic.

SOURCE: AMERICAN HIGHWAY USERS ALLIANCE

POTENTIAL FOR CATASTROPHE IN A MASS EVACUATION OF CITY RESIDENTS LOW HIGH





KANSAS CITY

The barbecue capital of the country is most likely to have the smoothest evacuation, thanks to decent traffic flow, capacious highways, and an absence of major natural barriers.



MIAMI

With water on two sides and the Everglades on a third, a swamp boat might be the best way out. Come disaster time, cars will get stuck in the automotive quicksand that is I-95.



NEW YORK CITY

The area's superb mass transit means most people here don't own cars. In an emergency, your best option will probably be a sturdy pair of sneakers (unless you have a helicopter waiting on your roof).

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experience

Overclock 'til you drop.

The NEW XPS 710 H_2C, with our exclusive two-stage cooling process, helps deliver virtually endless game play.

Let the cooling begin. Get a closer look at dell.com/blackice.

Dell's NEW XPS™ 710 H_2C Edition powered by the new Intel® Core™2 Extreme quad-core processor features a patent-pending two-stage process that allows you to push this PC to overclocked† proportions. This breakthrough technology helps cool the processor even at its highest mode, offering more efficient cooling than traditional air-cooled solutions. Combining a liquid radiator and a thermoelectric cooling module, this gaming goliath stays cool under pressure – up to 9 degrees* cooler in overclocked mode.

Dell™ XPS 710 H_2C

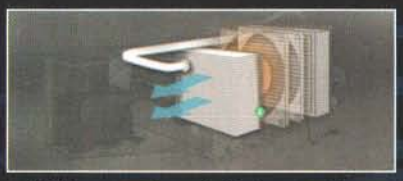
Starting at
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Dell recommends Windows® XP Media Center Edition.

Dell's exclusive two-stage technology:



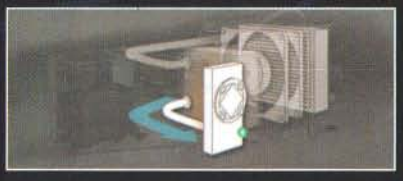
1. Inside-the-box innovation: Dell's exclusive H_2C hybrid technology.



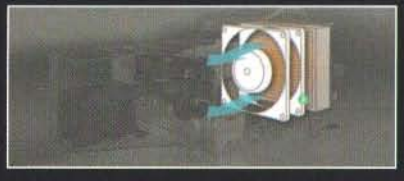
4. Fluid passes through the heat exchanger and is cooled a second time by the air system.



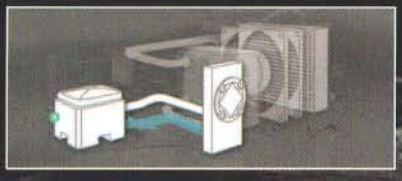
2. Heat from the air enters the radiator, beginning the cooling action.



5. Any heat dissipated by the CPU is transferred to the fluid system at the cold plate, which is cooled against the CPU.



3. The fan between the radiator and the thermoelectric heat exchanger pushes the air through, further cooling the flow.

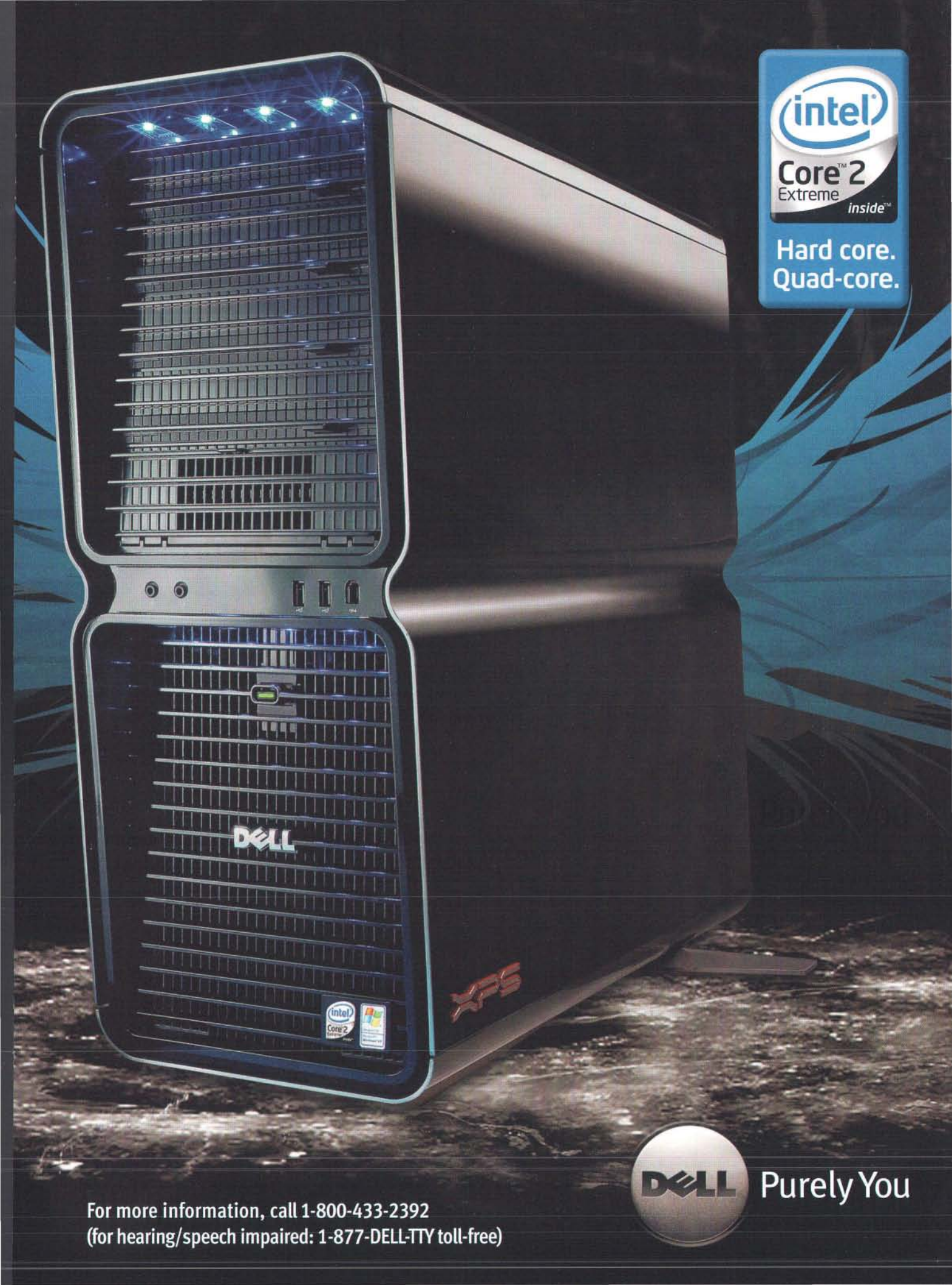


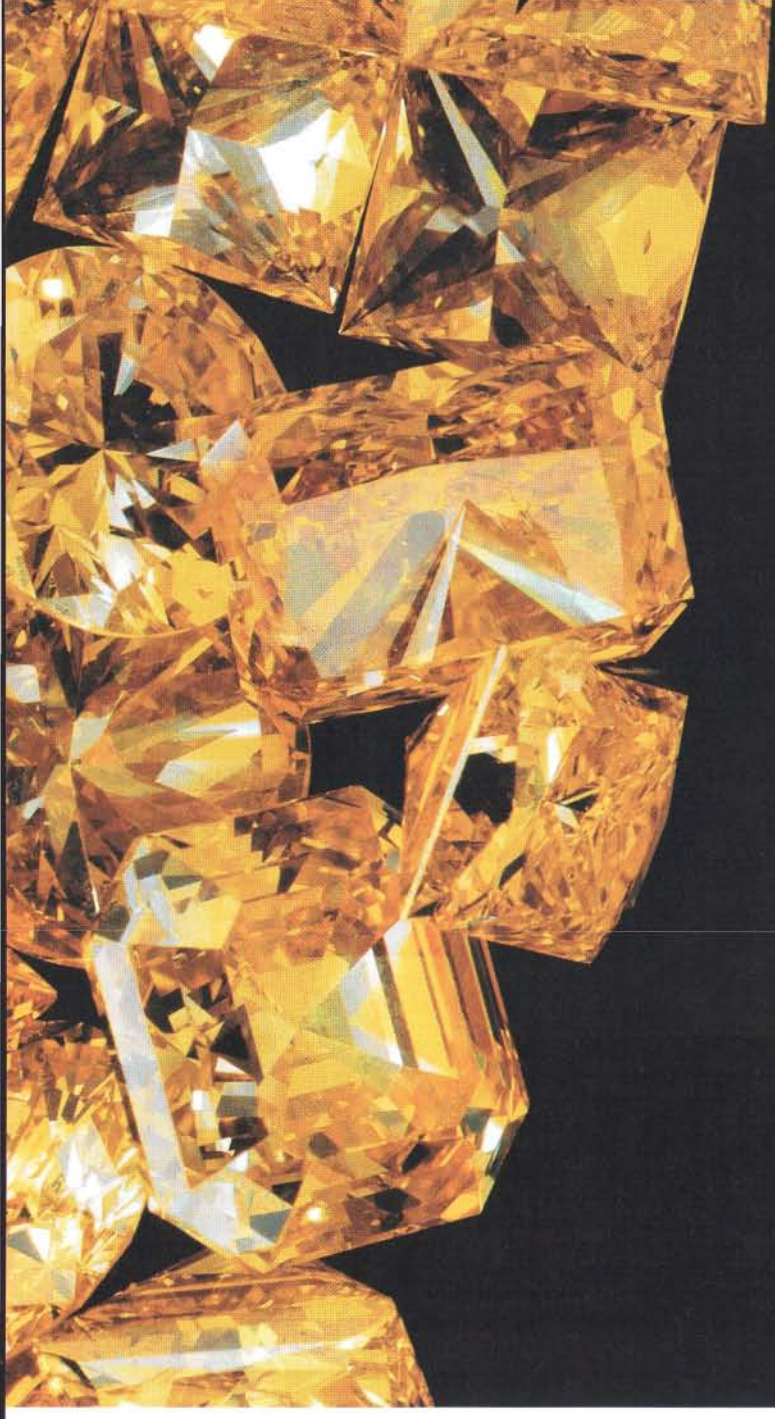
6. The circuit board manages delivery of 12VDC power to the thermoelectric cooling devices and regulates the speed of the pump.

†**OVERCLOCK:** Dell does not recommend operating the processor or other system component beyond factory default settings. Overclocking may cause system instability and reduce the operating life of your system components. Dell does not provide technical support for any hardware or software issues arising from any third party application, such as NVIDIA nTune 5.0, used to enable overclocking. Dell provides technical support only for overclocking settings available within the system BIOS.

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Updata

Lab-Grown Diamonds Make the Cut

This winter, a sparkling diamond landed in front of a technician at the Gemological Institute of America in New York City. He ran tests, noted the stone was man-made, and graded it as he would any diamond. It was the gem industry's strongest acknowledgment yet that lab-grown diamonds are just as real as natural ones.

For years, De Beers, the world's largest purveyor of natural diamonds, argued against the acceptance and GIA grading of lab-grown stones. But since 2003, synthetic diamond production has taken off, driven by consumer demand for merchandise that's environmentally friendly (no open-pit mines), sociopolitically neutral (no blood diamonds), and monopoly-free (not controlled by De Beers). As a result, Gemesis, the leading manufacturer of gem-quality diamonds (see "The Diamond Wars Have Begun," issue 11.09), has expanded operations rapidly. Three years ago, the company had 24 diamond-producing machines; now it has hundreds—matching the cash-value output of a small mine—and is turning on a new one every other day. "At this point, we operate like any other mine," says Clark McEwen, COO of Gemesis. "We produce rough diamonds in our machines and sell to distributors who do the cutting and polishing."

And despite their steady pronouncements of disdain, the old guard finally wants in. Michael Werdiger—one of only about 90 firms in the world that distribute De Beers' diamonds—has been buying Gemesis' yellow stones, a color that is particularly rare in nature. Because man-made yellows are increasingly plentiful, they sell for up to 75 percent less than natural yellows. Just a few wholesalers now supply Gemesis' stones to hundreds of independent and midsize chain jewelry stores in the US, selling out every month. "These diamonds exist," GIA spokesperson Laura Simanton says, "and we can't ignore them anymore." —JOSHUA DAVIS

And the Food? Out of This World.

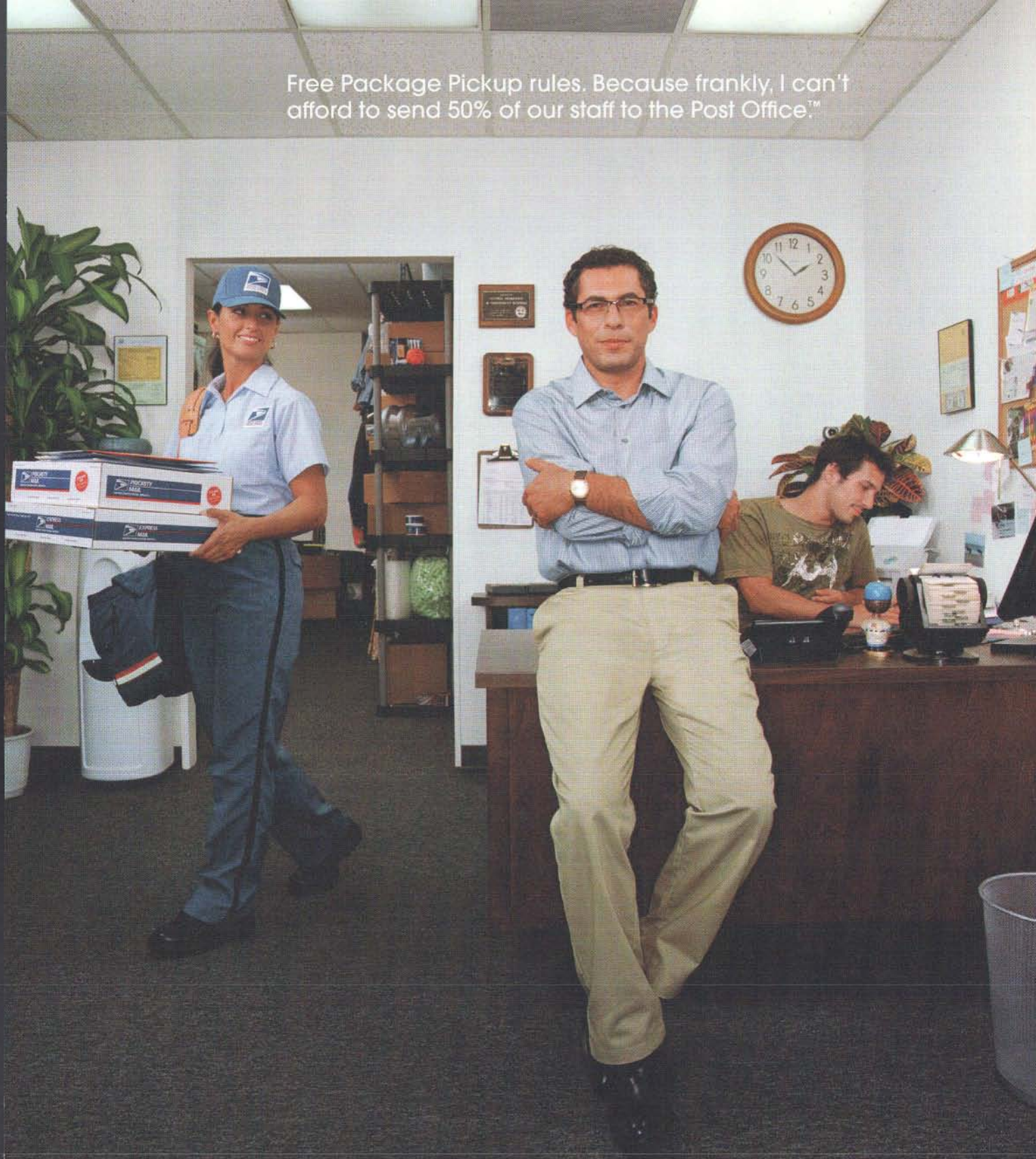
Getting three stars from the Michelin guide just wasn't enough. Now world-renowned chef Alain Ducasse is taking his stellar cuisine to the starry heavens. In October, the Russian cargo ship *Progress* left Kazakhstan's Baikonur cosmodrome, bound for the International Space Station with 13 Ducasse-created gourmet plates on board. These so-called special-event meals included roasted quail in a Madiran wine sauce, smooth celeriac puree with nutmeg, and semolina cake with dried apricots.

Ducasse isn't the first space chef—last summer the ISS crew had its mission kicked up a notch by Emeril Lagasse. But that was a one-off; Ducasse plans to launch two new dishes every year. Sealed in aluminum alloy and manganese boxes, the meals will mark special occasions like space walks and crew changes. "My chefs expected this project to be restricting," Ducasse says. "But they've been able to play with lots of products and techniques—with the pleasure of the astronauts as a goal." Astronaut Thomas Reiter tasted the gastronomic grub aboard the ISS in December and loved it. "But," he emailed, "we have no doubt that it would taste much better if we had some wine with it!" —JASON DALEY



DAVID CLUGSTON

ILLUSTRATION BY Tim Bower

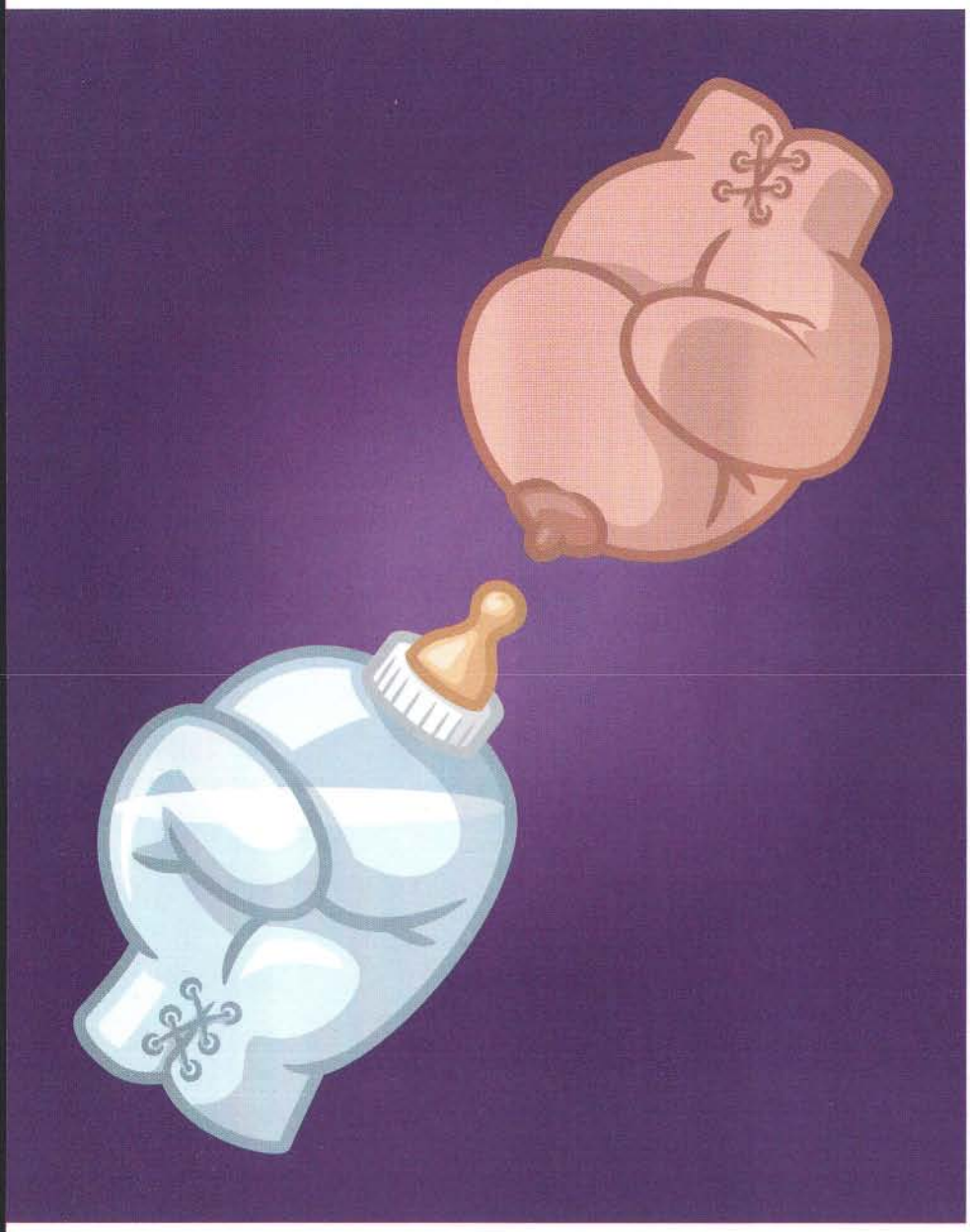


We're pretty much chained to our desks here. So this Free Package Pickup is huge. Betty picks up our packages on her stop and gets them right in the mail. Packages go. We stay. Click **usps.com/smallbiz** to learn more.

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The Boob vs. the Bottle

Am I a bad mother if I bottle-feed my newborn instead of breast-feed?

Mom, you're entering a social minefield. Feeding formula to an infant is liable to get you lectured by total strangers. That's because scientific studies have piled up like cordwood recently, all attesting to the same thing: Breast milk is awesome stuff. ¶ The evidence is convincing: Mother's milk provides a child with immunoglobulin IgA, which protects against infection. It contains DHA, a lipid associated with improved mental development—which may be why breast-fed kids tend to score higher than bottle-fed ones on IQ tests. Breast-feeding has also been correlated with lower rates of allergies, obesity, diabetes, and a host of other conditions. Scientists don't fully understand how the heck breast milk does all this, but hey, it was designed by evolution—the ultimate quality-assurance program. You can't argue with Mother Nature. "It's an absolutely remarkable food," gushes Mary Marine, a liaison for the La Leche League of Northern California and Hawaii.

But is it really so bad to opt for formula? Michel Cohen, author of child-rearing manual *The New Basics*, points out that breast-feeding rates rise with income, so all those superhealthy tikes may be in better shape not only because they've been breast-fed but because they live in more affluent households. Among his high-income patients in Manhattan, Cohen notices little difference between formula- and boob-fed babies. (This may also suggest that breast-feeding is most beneficial for poor and working-class families, where, ironically, mothers' jobs rarely allow for pumping milk or breast-feeding.) So, while Cohen advises moms to breast-feed, he doesn't think they should agonize about it. "I've seen mothers driving themselves crazy over this," he says. "If it gets like that, it's not good."

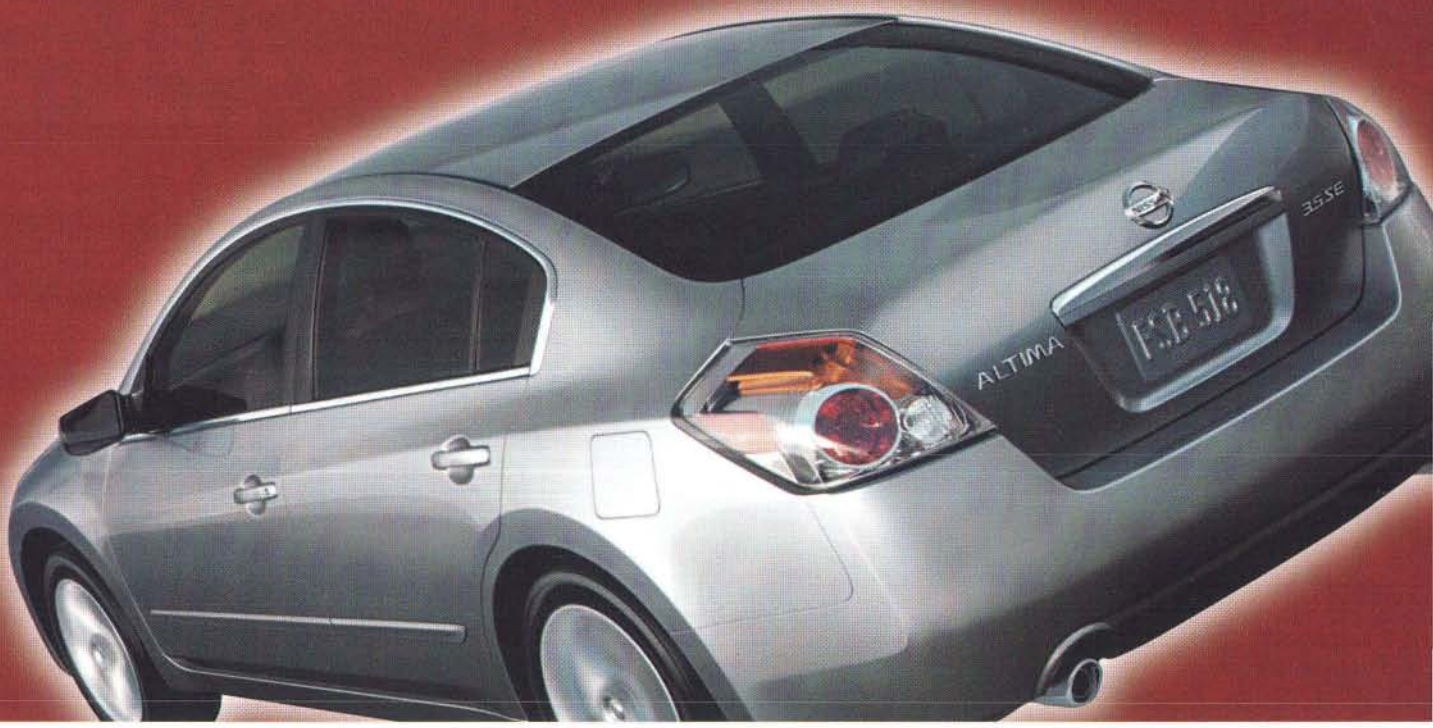
Try breast-feeding—it's healthier and may be less onerous than you think. And if it just doesn't work out, formula is fine.

I'm sick of having a weak-ass *World of Warcraft* character. Can I just buy a high-level avatar on eBay?

Sure, you *can*. On eBay, $300 will buy you a hot, female, level-60 warrior with Cloudkeeper legplates and a Hammer of the Northern Wind. IGE, the Wal-Mart of online »

ILLUSTRATION BY Christoph Niemann

Envy. Terrible to feel. Wonderful to provoke.



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worlds, will transform you into a demigod with the swipe of a credit card.

But when you show up online, prepare to be shunned. "You will look like a jerk," says Joi Ito, the venture capitalist who runs a *World of Warcraft* guild. Seasoned players can tell when someone is clad in unearned raiment. Those who spend months slogging up to level 60 learn the Elizabethan protocols that govern Warcraftian society—loot divvying, cryptic jargon, secret handshakes. You will have no clue, and they'll pick up on it immediately. "It takes a lot of practice, thinking, and time to learn how to play a character," Ito says.

Cliquish? Perhaps. But Edward Castronova, an economist who studies virtual worlds, points out that online games are the closest thing we have to truly meritocratic societies. Everyone enters *World of Warcraft* equally weak, and only through toil do heroes emerge. A store-bought identity makes you no better than a trust-fund brat: powerful by dint of your wallet, not your mad skillz. Money can buy you everything but cred.



My buddies keep asking me to be their friend on MySpace, Netflix, and other networking sites. How do I make them stop? "Reply to all invites with fake bounced-mail messages," jokes Sean Bonner, who created the parody site Isolatr after getting bombarded with invitations. If they still don't get the message, close all your social-networking accounts and send out elegant, handwritten notes explaining your actions. Everyone likes getting stuff in the mail.

Need help navigating life in the 21st century? Email us at mrknowitall@wiredmag.com.



ILAN RUBIN

Advanced Weaponry in the Pipeline

Like every surfer, LeRoy Whinnery mourns December 5, 2005, as Blank Monday. That was the day Gordon "Grubby" Clark shut down Clark Foam—the world's leading manufacturer of blanks, the foam cores for surfboards. But unlike other surfers, Whinnery knew of something that might replace Clark's suddenly unavailable formula for supermalleable polyurethane. It just had to be adapted from a rather unusual application: nuclear warheads.

Whinnery, a chemist with Sandia National Laboratories, was thinking of TufFoam, a light polyurethane compound designed to protect the sensitive electronics in bombs. Early last year, Whinnery and his team of defense engineers in Livermore, California, started tweaking the density of TufFoam to adapt it for wave-riding. After about two weeks and numerous consultations with surfers and board shapers, they produced a lighter derivative that's easy to work with and can withstand a pounding at the beach.

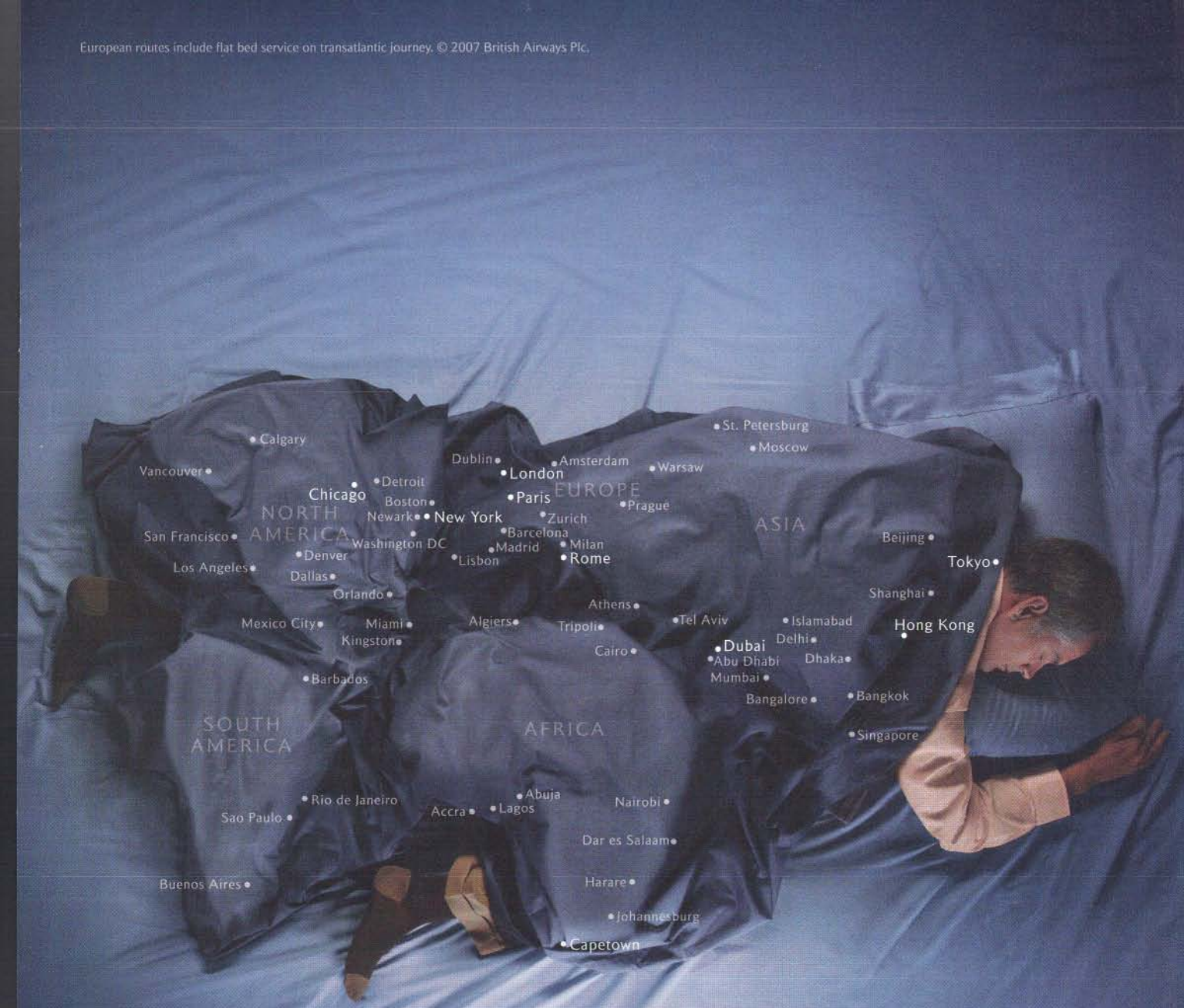
The lab has now created a series of foot-long samples that possess all the properties of the best boards without any of the offensive chemicals found in Clark's blanks. Moreover, in compression and crack-resistance tests, the low-density TufFoam actually outperforms Clark Foam, as well as other alternatives.

Sandia has licensed TufFoam to blank makers, and full-size boards are expected this year. Executives at the lab, run by Lockheed Martin for the Energy Department, say revenue will go toward other research. As Steve Goods, a materials scientist on the project, jokes, "We think of surfers as our first line of national defense." —HEATHER BOURBEAU

Composite foam used in nuke warheads may replace the cores of conventional boards like these.

ILLUSTRATION BY **Christoph Niemann**

European routes include flat bed service on transatlantic journey. © 2007 British Airways Plc.

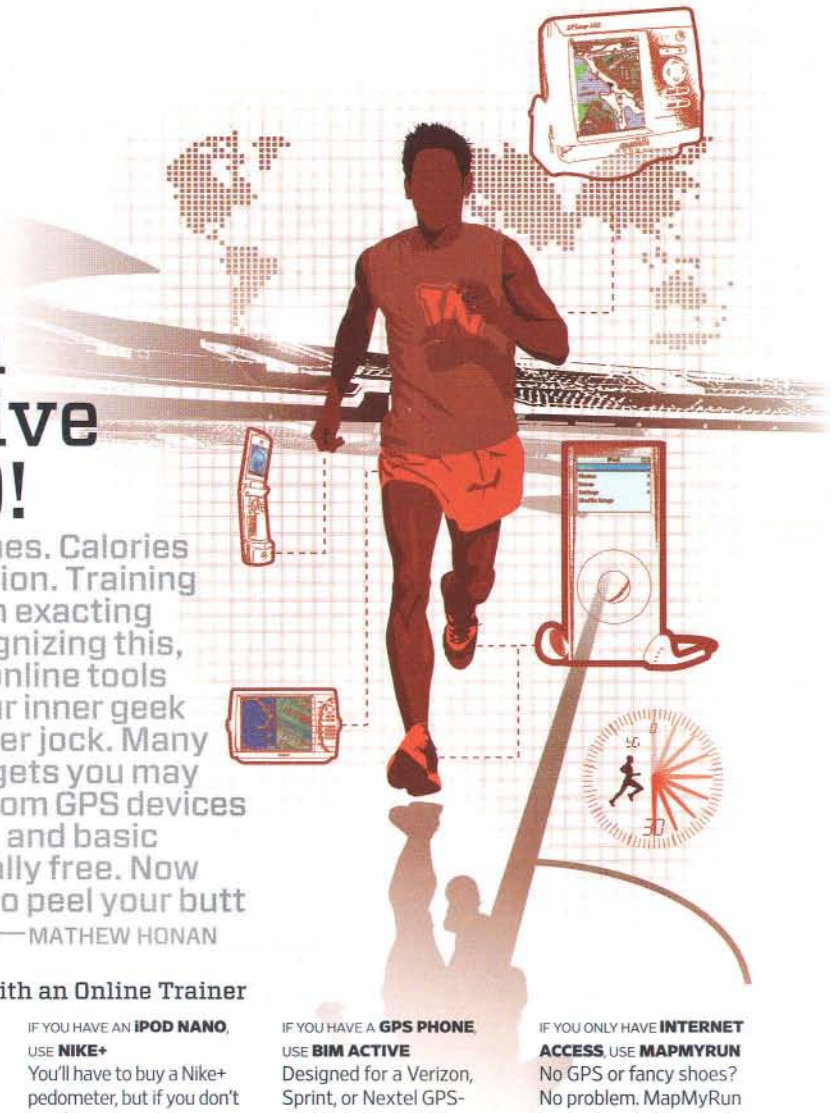


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Heart-rate zones. Calories burned. Elevation. Training has become an exacting science. Recognizing this, a slew of new online tools aim to help your inner geek coach your inner jock. Many work with gadgets you may already own, from GPS devices to cell phones, and basic service is usually free. Now you just have to peel your butt off the couch. —MATHEW HONAN

Pair Your Gadget With an Online Trainer

IF YOU HAVE A **HANDHELD GPS**, USE **MOTIONBASED**
This online app takes the data tracked by GPS units—time, distance, speed, route, elevation, and (sometimes) heart rate—and converts it into charts and Google maps of a run, row, or bike ride. Users can browse the site for new routes and, if they happen to own a Garmin GPS device, download others' results to create virtual races.

IF YOU HAVE AN **iPOD NANO**, USE **NIKE+**
You'll have to buy a Nike+ pedometer, but if you don't mind strapping it to your sneaks (or getting a pair of Nike+ kicks), the system transmits speed, distance, and other data to your nano. Whenever the iPod is synced, the info is uploaded to Nike's site, where you can create personalized goals or compete against others in invitation-only challenges.

IF YOU HAVE A **GPS PHONE**, USE **BIM ACTIVE**
Designed for a Verizon, Sprint, or Nextel GPS-enabled phone, BiM Active records speed, distance, route, and elevation, and calculates calories burned on your run. The software also provides audible distance and pace feedback over the phone and auto-uploads the results so users can chart their progress online.

IF YOU ONLY HAVE **INTERNET ACCESS**, USE **MAPMYRUN**
No GPS or fancy shoes? No problem. MapMyRun hacks Google Maps to let runners point and click their way to a better workout. Input your route on a virtual map, then enter your height, weight, and time, and the application calculates distance, calories burned, and pace. You can even share routes over the Web or via RSS.





Jargon Watch

spam 2.0
n. A pejorative for MySpace referring to the increasing use of social networking sites for promotional purposes. Many netizens have been disturbed to find out that products like Nintendo's Wii have more "friends" than they'll ever have.

DNA origami
n. Nanoscale structures made by exploiting the zipper action of DNA's double helix. While the first DNA origami was decorative (e.g., microscopic smiley faces), the technique could be used to assemble scaffolds for next-gen solar cells.

smishing
v. Phishing via text message. Smishers bombard cell phones with SMS versions of standard phishing solicitations, directing victims to Web sites that install spyware on their computers.

—JONATHON KEATS
(JARGON@WIREDMAG.COM)

BOB HAMBLY

ILLUSTRATION BY 500GLS

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Thinking Outside the Tube

Ever since Boeing introduced the 707 in the 1950s, passenger jets have looked pretty much the same: long tubes with tails, engines mounted below the wings. That shape may one day be transformed into the graceful silhouette of a manta ray. In February, a 400-pound, 21-foot-wide prototype of just such a bird will start practicing unmanned takeoffs, landings, and tricky slow-speed maneuvers at Edwards Air Force Base. Called the X-48B, it's a scaled-down model of a theoretical 500-ton, 240-foot-wide blended-wing aircraft. Aeronautical engineers have long known that this design could be much quieter, more fuel efficient, and far roomier than a conventional cylinder. But recent advances—lightweight composite materials, fly-by-wire controls, sophisticated flight systems—have made building one of these planes more feasible. Commercial versions have been proposed—imagine a flying auditorium—but the X-48B is more likely to debut as a US military transport plane circa 2022. —KARRIE JACOBS

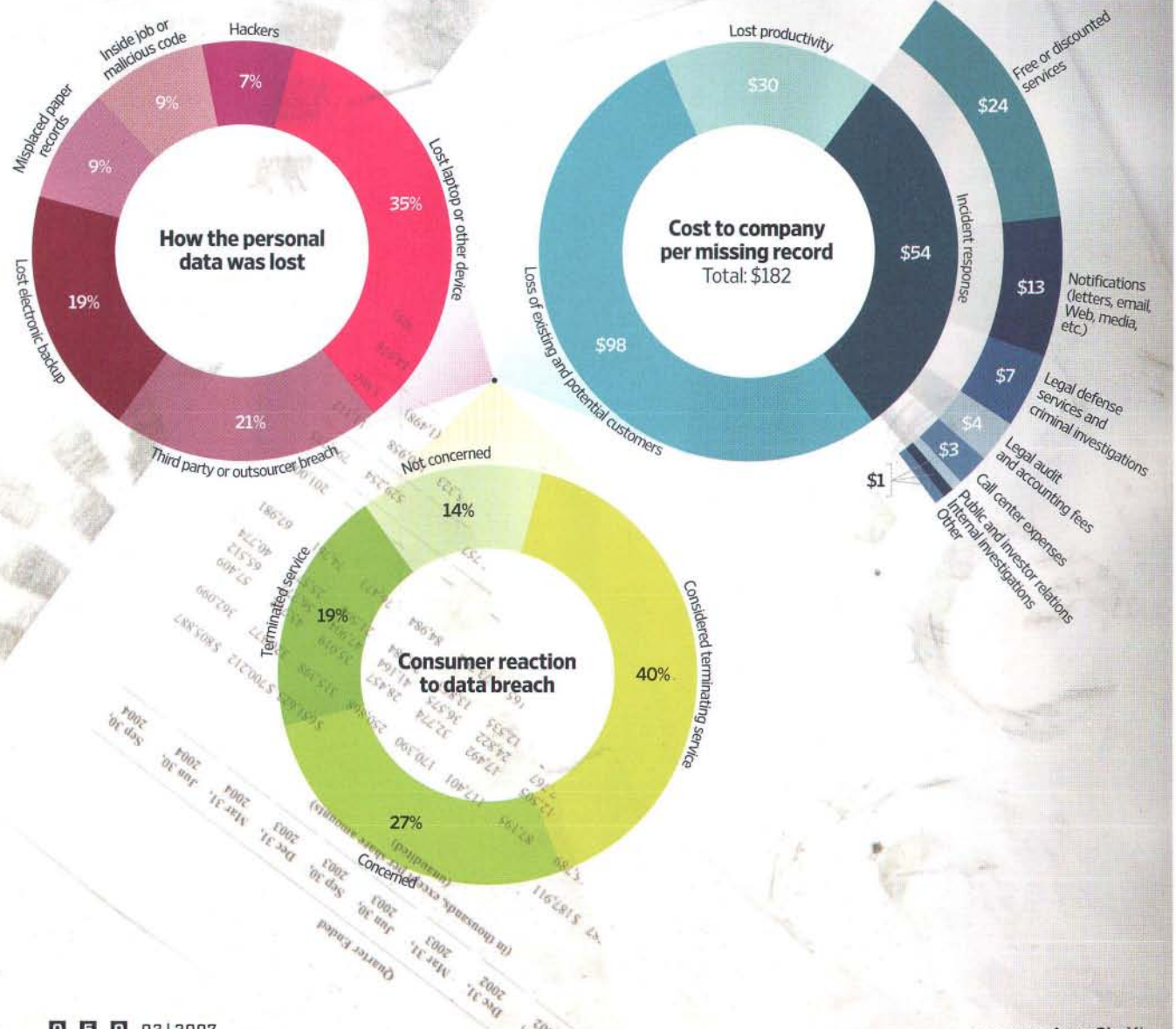


Old Dominion University
LFST
Large Full Scale Tunnel
X-48B

Your Secret Is Out

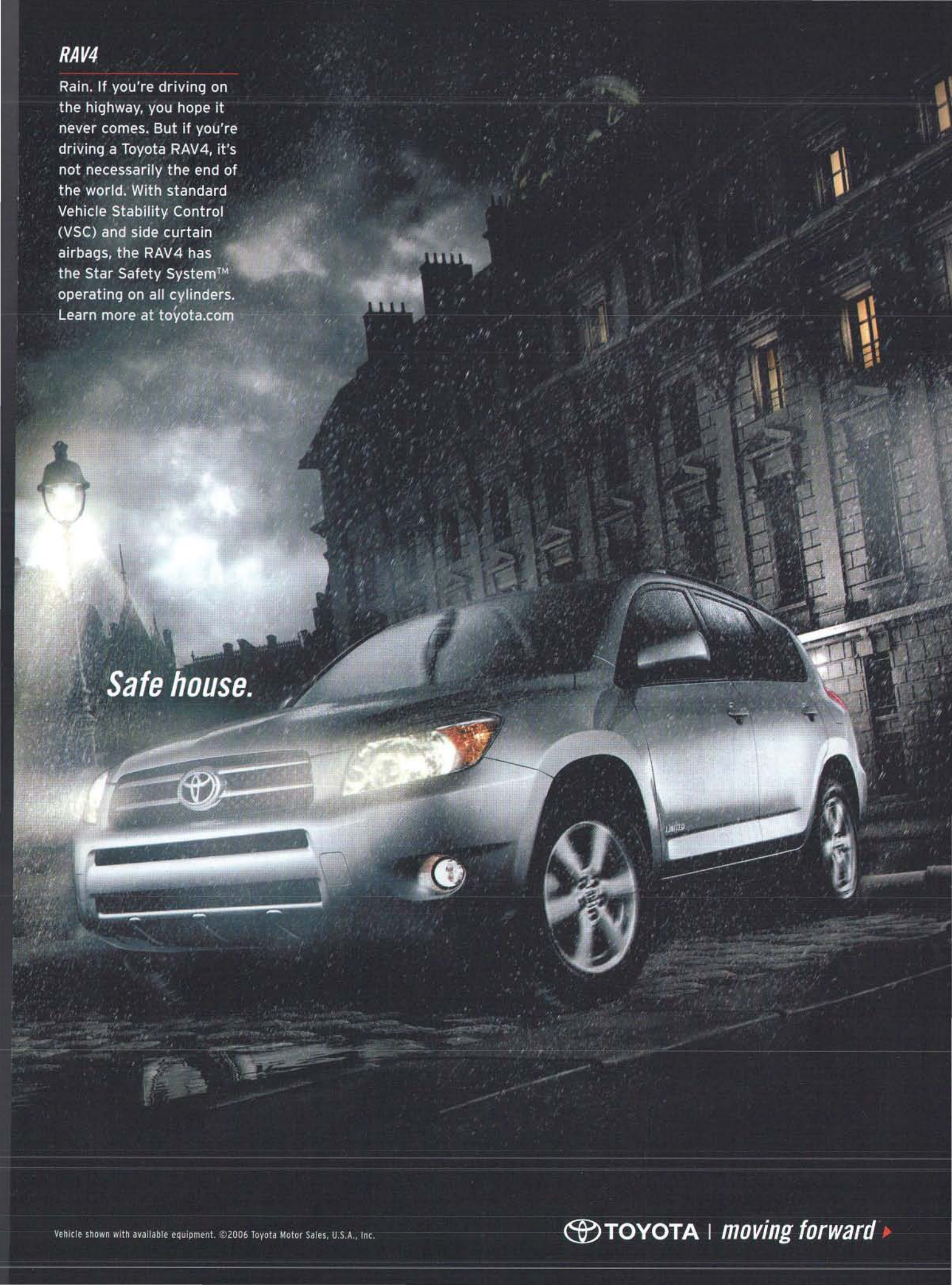
Data breaches cost companies billions each year.

"Whoops! We lost your personal data. So sorry." That's the gist of the millions of form letters Americans receive each year from red-faced corporations. Reading one of these mea culpas, you might picture your bank account numbers being swiped by some brilliant unwashed hacker in a dank basement in Gdańsk. The reality? Your nemesis is more likely to be a company employee who dumb-assedly left a work laptop on a crosstown bus. Through malice or stupidity, more than 100 million personal data records have been compromised in the past two years, at an estimated cost of $16 billion in extra paperwork, lost productivity, and lost customers. And those are just the incidents we know about: Only 31 states have laws requiring companies to notify customers when their data goes missing, and in many cases the loss of encrypted data doesn't have to be reported at all. We have met the enemy—and he just got off the bus empty-handed. —PATRICK DI JUSTO



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CHART BY Arno Ghelfi


RAV4
Rain. If you're driving on the highway, you hope it never comes. But if you're driving a Toyota RAV4, it's not necessarily the end of the world. With standard Vehicle Stability Control (VSC) and side curtain airbags, the RAV4 has the Star Safety System™ operating on all cylinders. Learn more at toyota.com
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MANAGED HOSTING



RoboCop, PhD

THE CELEBRITY SECOND ACT HAS BECOME a staple of pop culture. The press releases almost write themselves: Comedian becomes reality TV host, reality TV host becomes actor, actor releases mediocre rap album. But those second acts don't always sink to the level of cliché. Take Peter Weller. He's had a long, meandering Act I. After a vibrant movie career in the 1980s that included playing the lead in cult hits like *RoboCop*, he fell into the far less glamorous world of direct-to-video and straight-to-cable. Then last year, he came back big, in a riveting turn as a bad guy on *24*. ¶ In the interim, though, Weller started getting into character for Act II. He spent much of the past two decades in Italy and, on a lark, enrolled in classes at the Syracuse University program in Florence. He soon discovered he had a thing for the aqueducts of long-dead civilizations, and now he's working toward a PhD in Italian Renaissance art history from UCLA. This is no vanity degree; Weller teaches courses, writes papers, and is doggedly climbing the academic ladder. Buckaroo Banzai, the polymath who was arguably Weller's most famous character—acclaimed neurosurgeon, race car driver, particle physicist, and, of course, rock star—would be proud. "I've always followed my passions," Weller says, "even when it didn't seem to make much sense."

It's hard to imagine what freshmen think when they wander into Professor Banzai's lecture hall. Weller reports that he loses a lot of students after the first class. "They thought they were going to get the easy A from old RoboCop," he says with a laugh. The 450-page course reader tells them otherwise. Those who stay get a view into Weller's two worlds. For example, his class at Syracuse on Hollywood and the Roman Empire requires watching toga-and-sandal epics (*Ben Hur* and *The Last Temptation of Christ* among them) and reading primary-source Roman authors in an attempt to reconcile big-screen Rome with the real thing. "The Romans were an unbelievably complex people, and we are an unbelievably complex people," Weller says. "We can learn so much about why things are the way they are by looking at what they did." He goes on to explain how the absence of the concept of zero in Greek antiquity laid the foundation for Western philosophical thought.

All this boning up on the ancients has paid off for Weller professionally, too. He hosts the History Channel's *Engineering an Empire* series, which investigates Mayans, Egyptians, and other ancient peoples. And his latest acting gig is on stage as the brilliant but troubled architect Frank Lloyd Wright in the play *Frank's Home*, which opened in Chicago before heading off-Broadway. For an architecture buff, it's a dream role. "Wright is the one who burst things wide open, really created modern architecture," Weller says, and then he's off and running, explaining the connections between Renaissance buttressing, the power of the Church in the Middle Ages, and ancient heathen rituals still practiced on Italy's Amalfi Coast. The curtain rises on Act III. —MIKE DAISEY

ILLUSTRATION BY **Zohar Lazar**



Must-Stream TV

IT'S 10 O'CLOCK ON A SUNDAY MORNING, and actors Bob McClure and Lindsey Broad are sitting on an abused sofa on the makeshift set of *The Burg*, an Internet sitcom about underemployed urban twentysomethings. A grungy roll gate blocks any sunlight from seeping through the cracked storefront window. The walls are bare except for a tattered Zeppelin poster. Ceiling tiles dangle from their frames. It could be a Hollywood facsimile of a Brooklyn crash pad, but *The Burg* doesn't have the money for a set designer. Besides, who needs a fake crash pad when you've got the real thing? ¶ "Does everyone have their beers?" director Kathleen Grace asks. McClure and Broad hold up cans of Budweiser. ¶ "Are Jed and I still a pseudo-couple at this point?" asks Broad, whose character had an amorous encounter with Jed, the nerd-chic nebbish played by McClure, in a previous episode.

Grace ponders the question. At just 27, she is as much resourceful den mother as director. "Well," she finally answers, "you wish you were still fuck buddies."

Broad considers this. "I was talking to my drama professor," she says. "He thinks the last episode was really significant—that Jed and I crossed the Ross-and-Rachel turning point."

Grace rolls her eyes. Since its debut last May, the show has attained cult status, and drama professors aren't the only ones who think of *The Burg* as a *Friends* for the MySpace set. "We don't want Ross and Rachel," Grace says. "We want awkward and uncomfortable."

The actors shrug. "OK," Grace says, "let's shoot again."

If your Internet TV diet has been restricted to *Rocketboom* and *Ask a Ninja*, you might think the YouTube revolution is being waged by the video equivalent of garage bands, low-budget productions with really crappy equipment. *The Burg* follows a different model: It's produced with an actual cast and crew, using high-end digital video equipment. But then, the folks at *The Burg* aren't trying to remake TV—they're trying to break into it.

"It's like doing an off-Broadway play," Grace says during a pause in the shooting. "The actors do it because it's creative and fun, and we give them a lot of flexibility." And, in a perfect world, exposure to agents and casting directors. Naturally, these benefits come in lieu of cash. "We pay them in Red Bull," Grace says.

This approach has drawbacks—chiefly, having to arrange shoots around gigs that pay in a more conventionally liquid currency. Jeff Skowron, one of the principal actors, was recently cast in a Broadway production, and Grace and cocreator Thom Woodley have accommodated his six-day-a-week rehearsal schedule. "What can we do?" Grace says. "We all have to pay rent."

As a collection of extras assembles downstairs, it's time to resume shooting. The script calls for a party scene featuring a Russian drug dealer and a grim reaper figure. Budweiser tall boys are passed around. It's Sunday afternoon, but the beer quickly disappears, necessitating an emergency "prop" run.

Eventually, Grace decides she's got enough footage for the scene. Most of the extras filter out, but Skowron still hasn't arrived. The actors wait, entertaining themselves with show business horror stories while scarfing Domino's pizza.

Finally, around 7:30 pm, Skowron comes through the door, still in makeup. Matt Yeager, who will play opposite Skowron, takes his place in front of the camera. He looks down at his beer. "I've had about four of these," he says with a tipsy laugh.

The script calls for Yeager and Skowron to get into a fistfight. The two warm up by trading body blows and a few playful face slaps. The crew is cracking up, and even Grace—presumably exhausted from doling out Budweiser, hummus, and stage direction—laughs indulgently. Then it's time to roll camera. "OK, places," she calls. "Scene 26, shot K, take 5. Action!"

Yeager and Skowron deviate from the script a few times, but it's late and Grace seems pleased. "It's more important that they're in the spirit," she murmurs. Then she turns to the cast and crew. "I think that's it," she says with a smile. "We got it." —JEFF HOWE

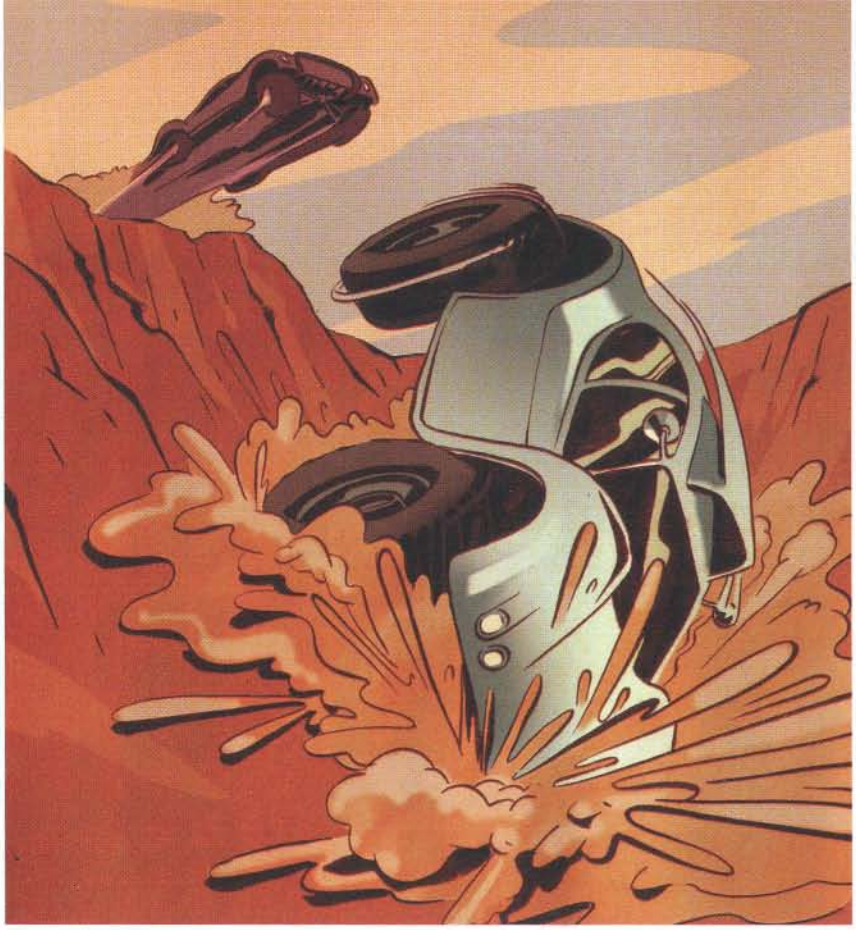
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The Desert Fox

RONN BAILEY'S RACE CAR HAS NO WINDSHIELD, a fact that has caused problems twice: once when the car drove through a swarm of bees and again when it came over a low rise and startled a flock of birds. ¶ At first, I find this troubling. But as we push 100 miles per hour across the ditch- and boulder-riddled southern Nevada desert, it becomes clear that there are more urgent things to worry about. ¶ "The rocks are what will get you. You have to learn to spot them," Bailey shouts, wrenching the steering wheel to clear a 4-foot-deep gully. "And they can be hidden! Behind bushes! There's a rock!" He points so suddenly that the car dives sideways and lists frighteningly on its suspension. I am, in that moment, extremely aware of my neck, which feels as thin and fragile as a daisy stem. "Do you see how focused I am?" Bailey demands. You've got to keep your focus every second when you're driving. Chess is good practice." I ask Bailey if he plays chess. He says no.

A three-time participant in the annual Dakar Rally—the venerable 5,400-mile off-road race from Europe to Senegal via the Sahara—Bailey is training in the desert outside Las Vegas. We're on a practice run in his test car: a scrawny buggy with splayed tires and a monstrous V-8 engine. It's not the rig he'll use in the rally (he doesn't want to wreck that one), but it handles the same.

As Dakar competitors go, Bailey is a strange entry. He spends his days as CEO of Vanguard Integrity Professionals, a Las Vegas company that develops security software for major corporate mainframes.

Squat and potbellied, with deeply recessed eyes and a ginger pompadour brushed so that he appears to be standing in a high wind, Bailey looks more like a retired Vegas emcee than a rally driver. At 57, he is also one of the oldest competitors entered in the 2007 race. "I have a unique problem," he declares at one point. "Five days into the race, my damn hands swell up." He flexes his fingers to show just how little they can bend. "I can't even hold a cup of coffee."

What distinguishes Bailey from other amateurs is his car—a carbon-fiber masterpiece that Team Bailey has put about $1.4 million into for this race, tricking it out with dozens of sensors (designed in part to protect the engine from meltdown), a hydraulic jack for getting out of sand dunes, and an onboard mechanical pump for changing tire pressure on the fly. How long these parts will survive in punishing race conditions is unclear, so Bailey is traveling with an entourage of three enormous trucks that are essentially high-end garages on wheels. "They've got plasma cutters, air compressors, raw metal for making parts," he says. "We can rebuild anything, even in the middle of the Sahara."

This is particularly important since Bailey is, by his own admission, one of the least capable drivers in the pack. During last year's Dakar, he cracked his car's frame on a rock, letting in so much dust and sand that his copilot had to be hospitalized. "I can't drive like the professionals," he says blithely, "so I'm building the toughest, most technologically advanced car in the race."

Even in the training stages, Bailey has been piling up accidents. While testing a newly tuned suspension system last fall, he rolled the vehicle and severely fractured his right arm. Not long after, he did what he describes as "a stupid thing"—gunning the racer over the lip of a seven-story sand dune. "Basically, I just went end over end all the way down," Bailey says. "The damn thing caught fire before it even hit bottom."

Hoping to perform better in Africa, he's developed a plan: Move competitively on the dunes in Mali and Mauritania, zip across the open savannas of Senegal, and go slowly on the technical sections scattered in between. "My strategy is to be the Rommel of Dakar," he says, referring to the German general who conquered North Africa during World War II. He throws the car into a 180, uprooting a small bush. "It's about the limit of control—and chaos." —JENNIFER KAHN

ILLUSTRATION BY Zohar Lazar



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1 Survivorman

On *Survivorman*, there are no back-stabbing contestants, silly tribal councils, or bogus immunity challenges. There is only Les Stroud, a Canadian filmmaker and outdoorsman who in each episode ventures into an inhospitable, far-flung locale (the Arctic Circle, Georgia swamplands) with little more than the clothes on his back and a 50-pound bag of video gear. His mission: Endure seven long days all alone in each uniquely punishing ecosystem, chronicling his successes (finding a puddle of water deep in a Utah canyon) and failures (getting lost in the depths of a Costa Rican jungle). In the process, he demonstrates how to snare a snowshoe hare with wire from a wrecked airplane and the proper technique for eating a wriggling scorpion like it's a jalapeño popper. The result: an hour of heart-pumping, stomach-churning reality adventure with the MacGyver of the Science Channel.

ILLUSTRATION BY **Josh Cochran**

play

2 8-Bit Operators: The Music of Kraftwerk

Is the technofuturist tunage of Kraftwerk not geeky enough for you? Interface with this tribute album to Düsseldorf's finest, which was made by some of the biggest artists in the chiptune world, where musicians use old Game Boys and Ataris as blippy lo-fi synthesizers.



3 Brass Goggles

Great Babbage's ghost! This blog is dedicated to ferreting out cool examples of steampunk—the sci-fi subgenre that imagines a retrofuturist Victorian England overrun with difference engines and giant steam-powered robots. Goggles highlights old-school tech in videogames like *Rise of Legends* and *Thief II* and in anime like *Last Exile*. Don't miss the photo of one of the world's first typewriters.



4 Xbox 360 HD DVD Player Officially, this drive connects to your Xbox 360 and lets you watch hi-def movies. Unofficially, with a few simple hacks, it can be hooked up, sans 360, directly to a PC or TV—giving you lag-free, sparkling HD for a grand total of $200. That makes it one of the most inexpensive, high-quality HD DVD drives on the market. (Similar off-the-shelf drives can cost more than twice as much.) How to? Find the software drivers on BitTorrent, and download them to the drive via its USB port. Nota bene: Our lawyers want you to know that this may void your warranty.

5

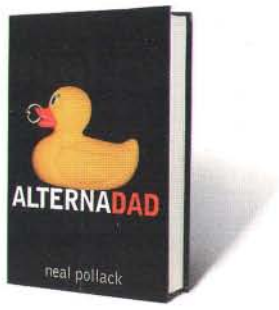
Games Factory 2
Stick it to the big game developers with this nifty piece of software. *Games Factory 2* lets you design and build your own videogame—no mad coding skillz necessary. Drag ready-made icons or drop a customized avatar on a playing field to concoct your electronic escapade. Included debug software ensures a glitch-free gaming experience. For just $59, you'll never have to squander your hard-earned quarters at the arcade again.

6 Neil Young: Live at the Fillmore East
Neil Young, progenitor of grunge, opens his vaults and kicks off his long-rumored archive series with a vintage Crazy Horse set from 1970. A notorious stickler for high fidelity, Young spent years remastering his basement tapes. The resulting pyrotechnics between Young and the late guitarist Danny Whitten are something to behold.





7 Idiocracy
Last fall, Fox released Mike Judge's hilarious social critique in theaters in only seven cities, guaranteeing its failure. Stupid move, but lucky for us it's now on DVD. Luke Wilson stars as an under-achiever who wakes up in 2505 and discovers a world so dumbed-down (to wit: the most popular TV show is called *Ow, My Balls!*) that he's the smartest person alive.



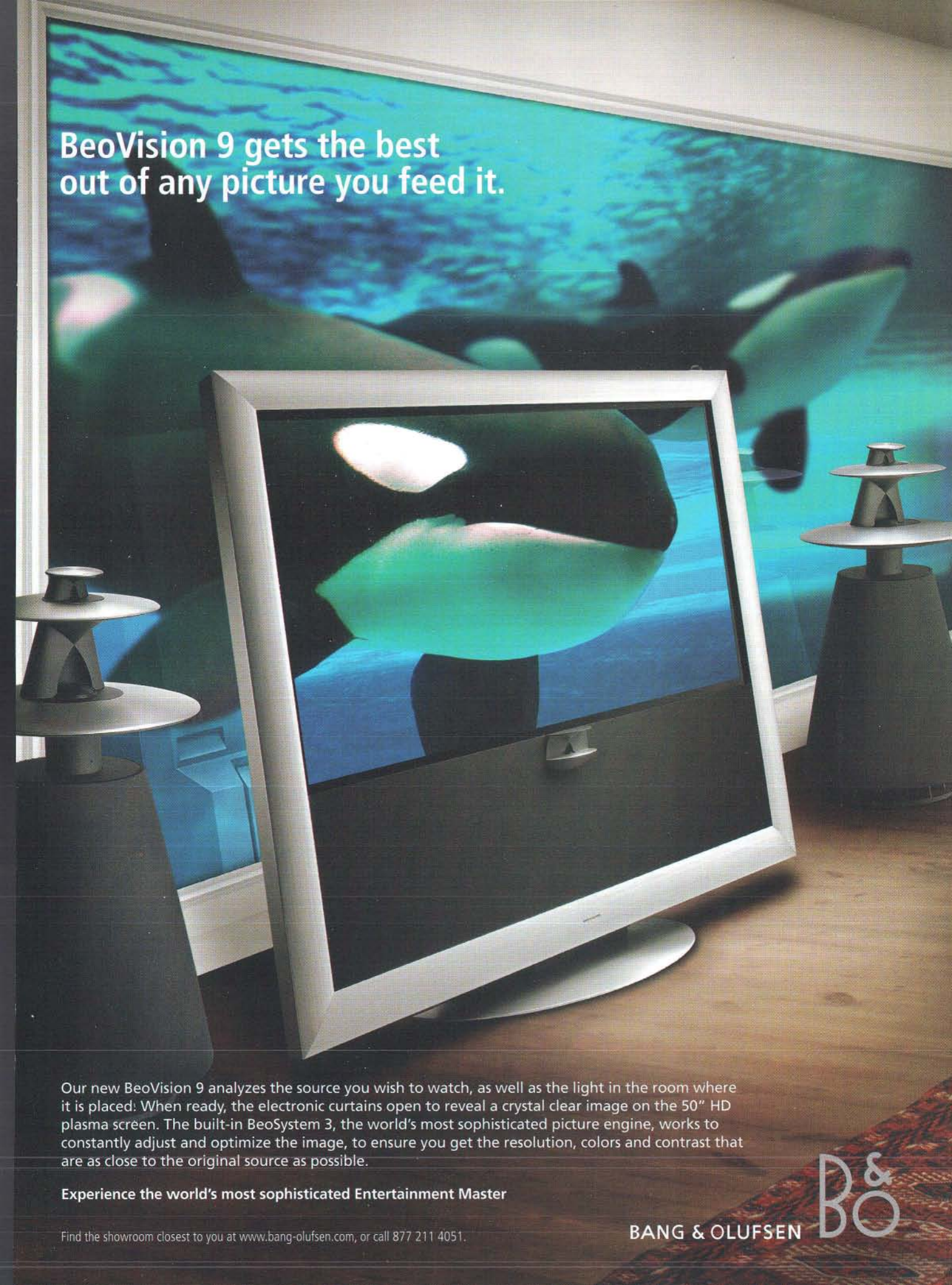
8 Alternadad by Neal Pollack
Writer and aspiring rock star Neal Pollack chronicles his journey from single hipster pothead to married-with-child hipster pothead. While the genre—unlikely parental candidate explores the decision to breed and its consequences—isn't exactly unique, Pollack's take on the milestones of fatherhood (like how he coaxed a wayward noodle out of his 2-year-old's nose) is.

9

Motorola Bluetooth DJ Headphones S805
We admit it: We're addicts. These babies pair with any Bluetooth-enabled stereo device to let you skip, play, pause, crank up, or dial down your music. Plus, they solve the most annoying problem of full-size 'phones: Big sound comes at a Faustian price (namely, a thick, 6-foot-long cord). Thanks to Bluetooth, there's no cord at all. Throw in the ability to pause your tunes automatically when you answer a call and you get must-have earwear for the urban techno-audiophile.

10 Swivel.com
Imagine our delight at a Web site that not only lets you play with other people's data but also helps you make your own charts! (Yes, we're nerds; and that surprises you *why*?) Upload Excel files or enter your own figures. From there, create a mashup of your data with someone else's, pick a pretty chart style, and kiss Excel ugliness good-bye.

ILLUSTRATION BY Josh Cochran



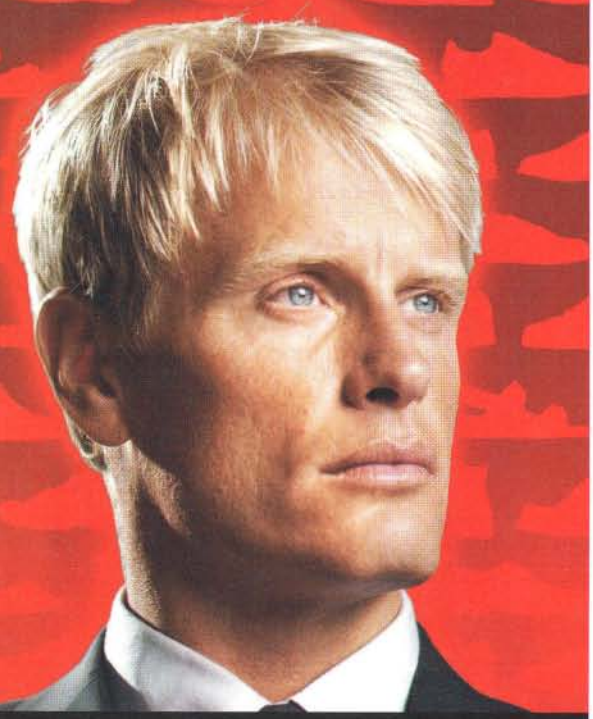
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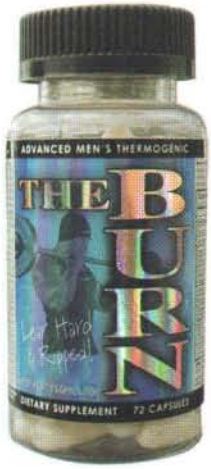
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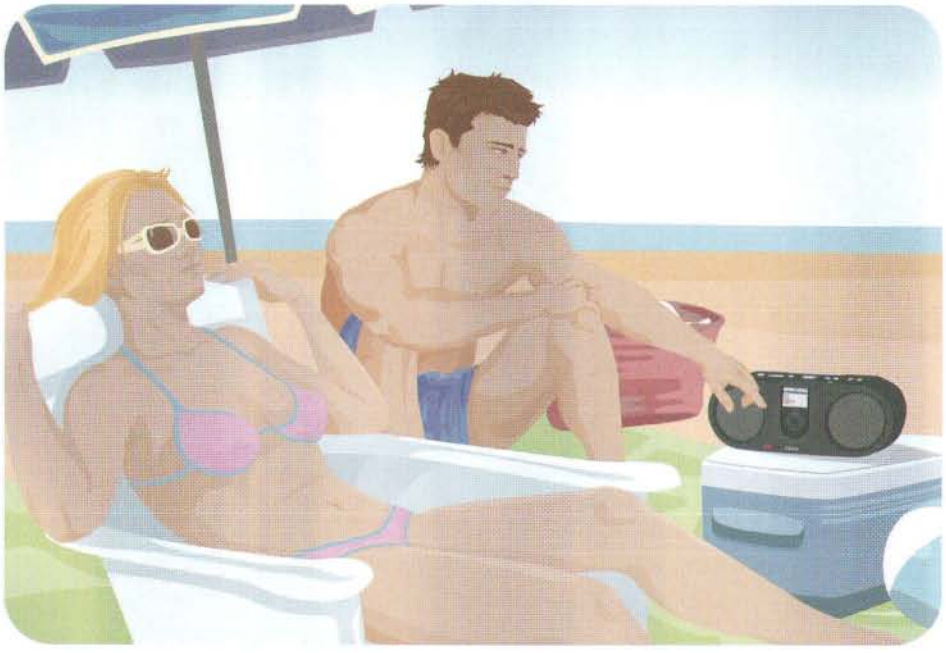
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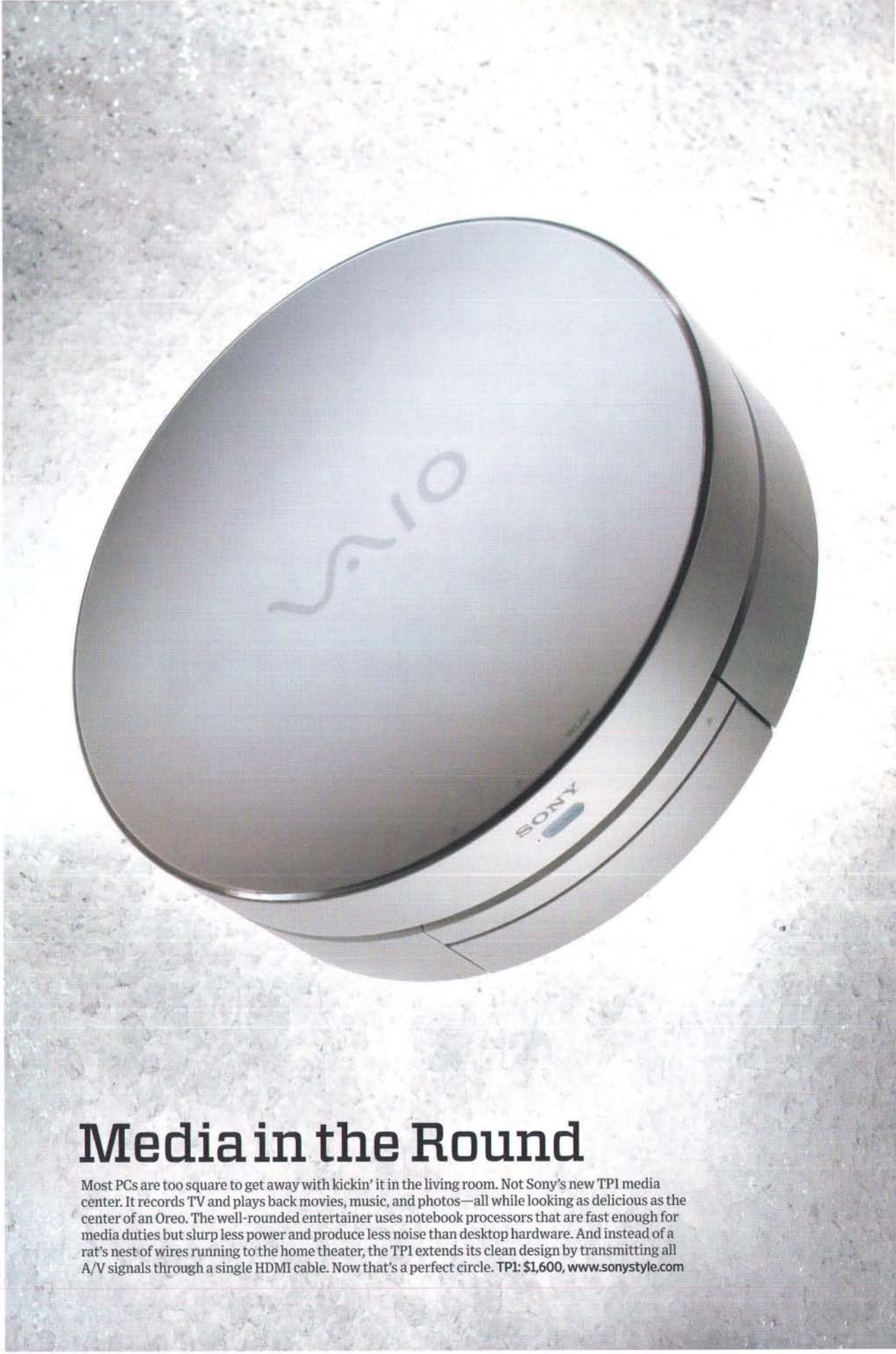
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Media in the Round

Most PCs are too square to get away with kickin' it in the living room. Not Sony's new TP1 media center. It records TV and plays back movies, music, and photos—all while looking as delicious as the center of an Oreo. The well-rounded entertainer uses notebook processors that are fast enough for media duties but slurp less power and produce less noise than desktop hardware. And instead of a rat's nest of wires running to the home theater, the TP1 extends its clean design by transmitting all A/V signals through a single HDMI cable. Now that's a perfect circle. **TP1: $1,600, www.sonystyle.com**

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PHOTOGRAPH BY **Todd Tankersley**

Portable Lodge

Burton's latest winter sport bag is an après-ski multitool. It features a laptop sleeve, built-in speakers, and a CD wallet, protected by a metal frame that unfolds into a chair. Oh, and there's a dedicated pocket for a deck of cards and an insulated compartment for a shot glass and a bottle of booze (or a thermos of hot cocoa), as well as a bottle opener on the keychain. What, no swimsuit pouch for impromptu hot-tubbing? **Liquid Lounger: $130, www.burton.com**



Swivel Servant

This MacBook doppelgänger from Toshiba may be housed in a familiar white chassis, but it's got the substance to back up its style. The 12.1-inch wide-aspect LCD flips over to unleash a full tablet PC, while an external digital display allows you to see email alerts and calendar entries without popping the lid. It runs Microsoft's new Vista OS like a champ, and at less than 4 pounds, you can tote it anywhere. **Portégé R400: $2,599, www.toshiba.com**

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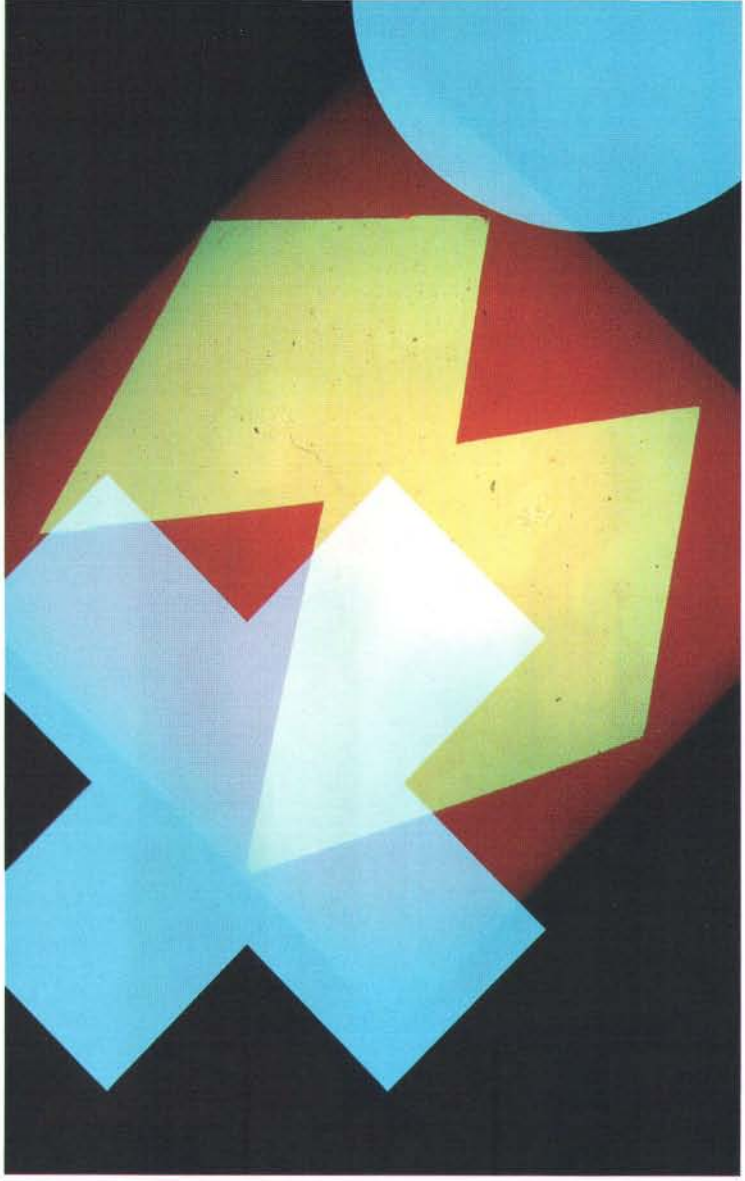
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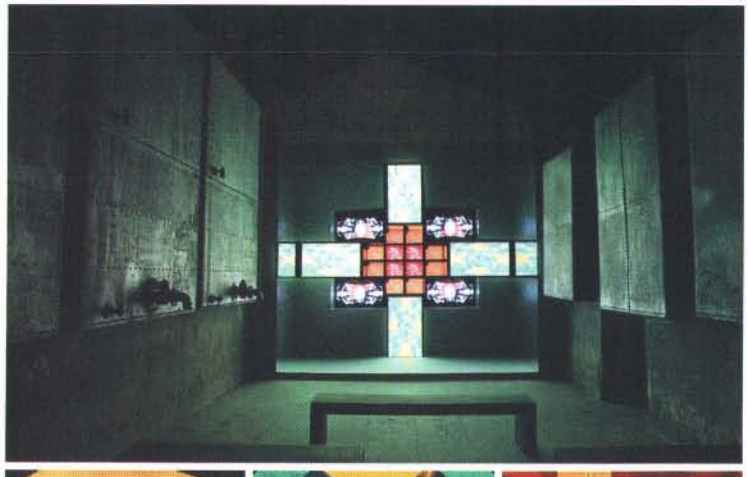


Master Mix

Brian Eno's morphing mashup of music and art.

The avatar of ambient, Brian Eno, has transformed the mashup into fine art. The musician's installation, *77 Million Paintings*, is a multiscreen mélange of audio snippets and 300-plus images, including scans of his own paintings and snapshots. The morphing collage—typically displayed on up to 35 monitors and three 13 x 10-foot projection screens—has appeared at the Venice and Milan biennials and is headed to England in late winter for exhibitions at Selfridges' Ultralounge in London and the Baltic Centre for Contemporary Art in Gateshead. The visuals, which Eno culled from his work over the past 20 years—like his Crystals series from the '80s, sketched out in the notebook above—can form more than 77 million combinations (thus the name). With the help of a programmer, Eno used off-the-shelf applications like Photoshop and Macromedia Director to create the generative software that orchestrates the digitized sounds and images. But the best part? You can get your own *77 Million*: The entire exhibit is available on a DVD that will play on most computers. That's a lot of art for 40 bucks. —ASAMI NOVAK







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*Compared with a typical laser product.



Hot, Live Indie Action

MP3 blogs tend to exhibit sharklike behavior: Too many sites join feeding frenzies over too few worthwhile (and mostly illegal) songs that stream like they've been downloaded off an answering machine. Daytrotter is the exception. Influenced by the late, great John Peel (whose legendary BBC radio show boosted many a budding career, from Bowie to the White Stripes), Davenport, Iowa-based music critic Sean Moeller and engineer Patrick Stolley launched the site to showcase MP3s of live, in-studio sessions with some of indie rock's hottest acts, including recent guests French Kicks, Vietnam, and Of Montreal.

Daytrotter's recordings are known for their warm, fluid sound, the result of the studio's candy shop of vintage gear, including a Rhodes piano, a Lowrey tube organ, and a dozen Spectra Sonic preamps. "We record straight to quarter-inch tape," Moeller says. "There are no overdubs. No ProTools. What you hear on the site is exactly what happened that day."

Since its launch in March 2006, Daytrotter has become a favorite destination for music fans (with half a million downloads) and a welcome tour stop for hip bands. "I love our recordings," Of Montreal frontman Kevin Barnes says. "The way they approach music is a cool reaction to the digital, overproduced sound that you usually hear on the Web." —ERIC STEUER

Session man: Daytrotter's Sean Moeller in the site's Rock Island, Illinois, studio taping Southern-fried indie rockers Catfish Haven.

Play Music

Reviews



Clap Your Hands Say Yeah

SOME LOUD THUNDER

In 2005, CYHSY's breakthrough generated a lot of applause—and more than a little hype. Fortunately, the NYC via Philly quintet's follow-up keeps the buzz aloft with some help from Flaming Lips producer Dave Fridmann. —Steven Leckart



Bloc Party

A WEEKEND IN THE CITY

Kele Okereke's icy vocals and Russell Lissack's muscular guitar riffs push Bloc Party's sound beyond jagged dance-punk revival (and Franz Ferdinand comparisons) into potent, melody-driven power-pop. —Ken Taylor



The Bird and the Bee

THE BIRD AND THE BEE

Inara George, silken-voiced daughter of Little Feat founder Lowell George, and multi-instrumentalist Greg Kurstin conspire to mix electronica and jazz into a buoyant, head-bobbing confection. —Kristina Feliciano

PHOTOGRAPH BY Baerbel Schmidt

Fold so A meets B (A)

(B)

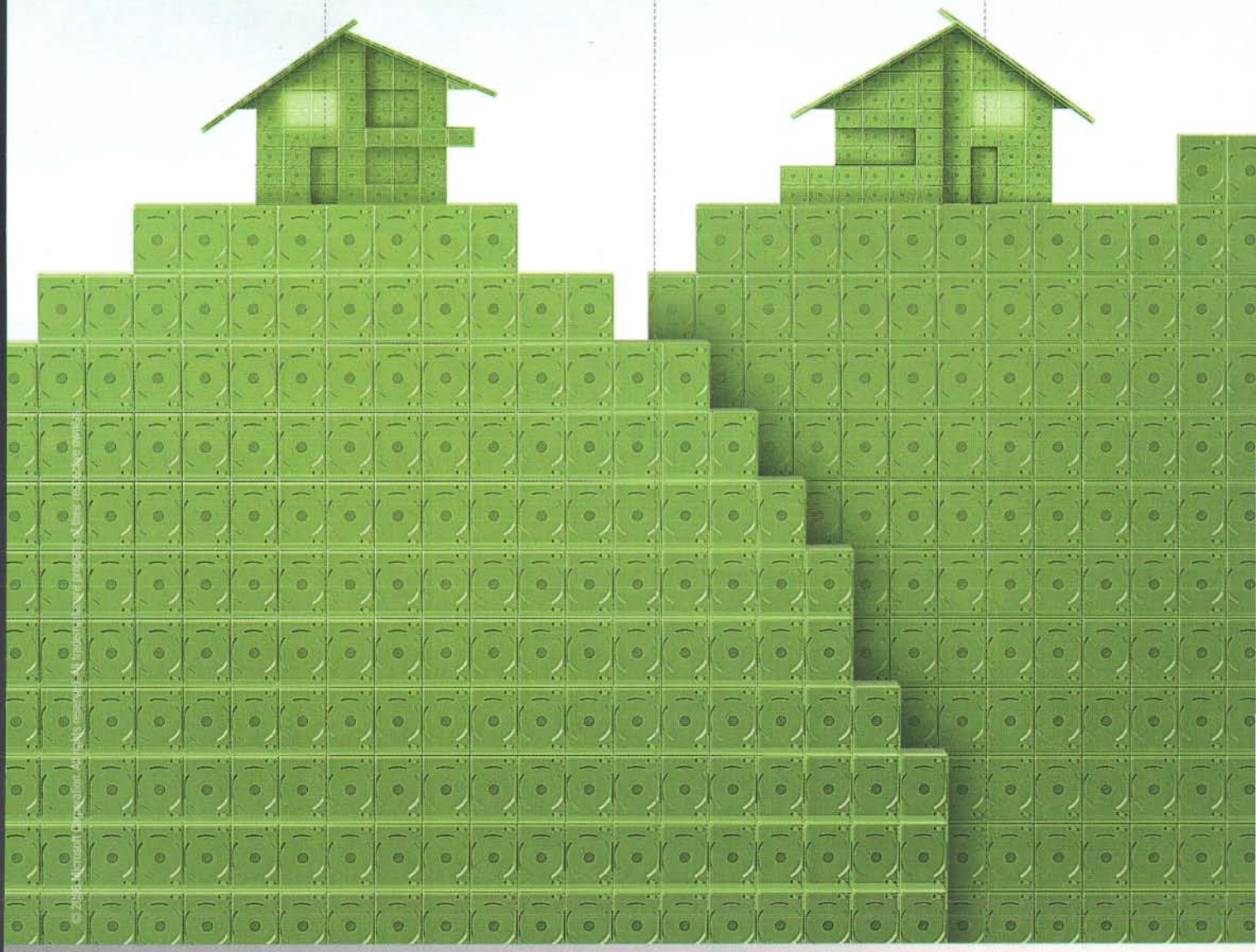
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XBOX 360™



All-You-Can-Play Buffet

Cinephiles have Netflix. Music geeks, Rhapsody. And gamers? GameTap. Introduced in 2005, the subscription service lets PC users with broadband sample an all-you-can-play smorgasbord of more than 800 titles—current hits and perfect emulations of classics—for just $7 a month. Scroll through the wraparound menu and pick from such arcade mainstays as Dig Dug **(A)** and Final Fight **(B)**. Also on tap are scores of games from vintage platforms like Intellivision and Sega Dreamcast (Amiga and Sega Saturn titles are brewing). All integrate AIM chat for trash-talking, and several old-school darlings have been upgraded with online multiplayer capability, so you can play, say, the 1977 Atari standard *Combat* against some foul-mouthed punk in Sweden.

But GameTap isn't content simply to republish existing titles. It has provided funding and distribution for the cult-fave adventure *Sam & Max: Season 1* **(C)** since LucasArts dropped the franchise, and it rescued *Myst Online: Uru Live* **(D)**, the MMORPG version of the venerable puzzle-solving series that Ubisoft canceled before it launched. Next up: GameTap has enlisted several hot comic book writers to script animated shorts based on Activision games like *Pitfall!* and *River Raid*. Geek-tastic! —CHRIS KOHLER









Reviews



XBOX 360

Lost Planet: Extreme Condition

In the opening scenes of this gorgeous sci-fi actioner, a green-eyed alien or some such has killed your father, and you're ticked off about it. Vent your wrath by going genocidal on an army of giant insectoids straight out of *Starship Troopers*. Thankfully, you don't have to use a colossal can of Raid—there are guns aplenty and a humongous suit of robotic armor to help you kill bugs dead. —James Lee

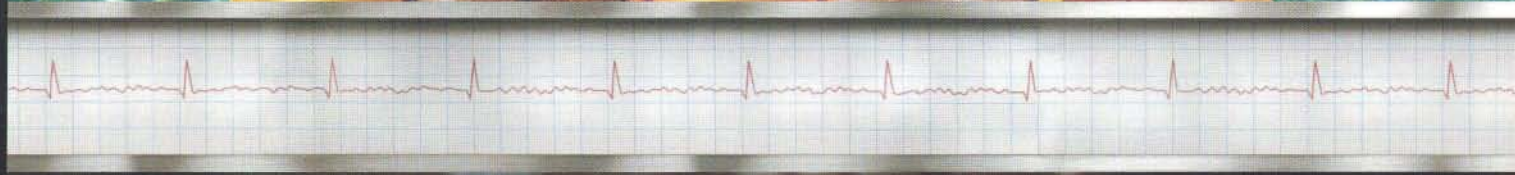


NINTENDO DS

Phoenix Wright: Ace Attorney Justice for All

This delightfully bizarre game mixes manga-style artwork with *Law & Order* drama. The courtroom combat is purely verbal: You select the conversational path by poking the screen with the DS stylus or shouting "Objection!" into the microphone. The real pleasure comes from your jaw-droppingly weird caseload. At one point, you lead a tense cross-examination of a ventriloquist's dummy. —C.K.









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GRAB LIFE BY THE HORNS

DODGE









The People's Magic Bus

The Volkswagen bus: 1960s beach bums dug it, brah. And no wonder. It was cheap, had plenty of room for surfboards, and was about as complicated as a lawn mower. That's why, when Volkswagen of America's Electronics Research Lab in Palo Alto wanted an unassuming vehicle to house some of its undercover tech, it settled on a roomy, 21-window Deluxe Microbus from 1964. Dubbed Chameleon by the ERL team, the van—purchased on eBay for $20,000—has been completely restored, converted to electric drive, and stocked with the lab's souped-up automotive electronics. But the best part? It still looks boss on the beach. —MIKE SPINELLI

A) ALL-ELECTRIC POWER
The Paleolithic air-cooled engine, which once put out double-digit horsepower, has been replaced with an electric motor fueled by 10 lithium polymer batteries. The plug for recharging is hidden inside the false tailpipe, and rooftop solar cells mounted on two surfboards provide additional juice the natural way.

B) MOBILE ENTERTAINMENT
Can't catch a wave? Catch a movie instead. A 42-inch Sony LCD rises into place behind the front seats at the touch of a button. The rear window glass changes electronically from transparent to opaque, doubling as a movie screen for a digital media projector. Plus, the MP3 player responds to voice commands.

C) BIOMETRICS
In lieu of a key, an infrared palm-vein scanner built into the gas cap identifies the driver. The system can be programmed for multiple users with separate security levels (door unlock only, door unlock and startup, et cetera). Similar ID systems are already in use at ATMs in Japan and top-secret US government facilities.

D) INFORMATION CENTER
A circular digital instrument cluster mimics and updates the original analog speedometer, acting as a central information hub with a graphical user interface and speech recognition to control the bus's various functions. It also serves as a display for the nav system, which links with Google Earth to provide 3-D maps.

Play Motor



One Badass Tricycle

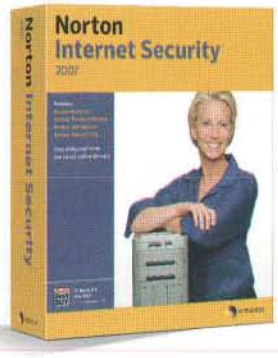


Mod Vespa purists may scoff, but Piaggio's latest scooter, the MP3, is way more gear than its reverse-tricycle appearance suggests. Twin front wheels keep the bike upright on the bumpiest streets, while an innovative electrohydraulic suspension system lets them tilt independently, which means the rider can lean aggressively into corners at angles of up to 40 degrees. An automatic suspension-locking system stabilizes the rig at speeds under 7 mph and eliminates the need for a kickstand. Plus, there's enough storage for two full-face helmets, a small bag, and objects up to a meter in length—like, say, a Genoa salami. —M.S.

VW PHOTOGRAPHS BY Toby Burditt

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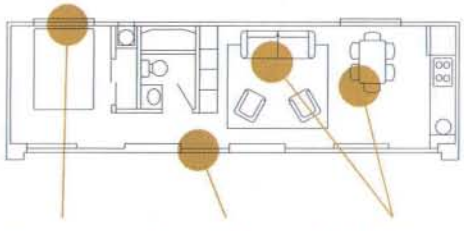
One Trailer, Hold the Trash

Priced out of the housing market? Obsessed with design? This glass-walled mobile is low-budget high living for the modern nomad.



It may be a mobile home, but the Glassic Soho won't be mistaken for any of the single-wides dotting trailer parks across the US. Developed by San Francisco architect and furniture designer Christopher Deam, it's a sleek, modern alternative living space. At just north of $59,000 for the fully furnished house (wheels included), the Glassic costs at least $10,000 more than a typical trailer. But its target market—think Eames-loving design sophisticates—seems shocked by how cheap the 400-square-foot abode is. "We're attracting a customer who says, 'We wouldn't buy anything else you sell, but we love this,'" explains Denise Walsh, a sales rep at Breckenridge, which manufactures the Glassic.

Of course, there's a catch: building codes. Trailers like the Glassic are classed as recreational vehicles, which means most municipalities do not treat them as permanent dwellings. Some towns let you plant these stationary vehicles on any land you own. Others restrict them to rural areas. Either way, Deam has plans for the much-derided trailer park: "If you had 40 of these instead of 40 trashy trailers, suddenly you'd have something." —ANDREW BLUM



DRAG AND DROP
Transporting a Glassic to your homesite runs up to $6,000. Simply rest the unit on cinder or limestone blocks, then hook it up to the local water and power systems. Oh, and don't forget the broadband.

MULTIPLE BLUEPRINTS
Pick from among three floorplans: one-bedroom, two-bedroom (no kitchen), or studio. All units come standard with a floor-to-ceiling wall of glass (motorized roller shades optional).

FURNISHED LIVING SPACE
The Glassic can be outfitted with all the creature comforts of a permanent home—hide-a-bed sofa, dining table with seating for six, queen-size bed, washer-dryer, fireplace, and entertainment system.

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All other vacuums clog.

Not a Dyson.

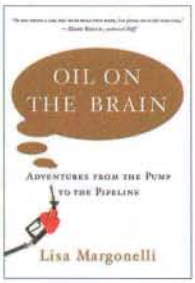


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dyson

www.dyson.com

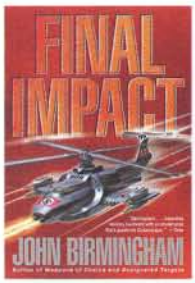
Reviews



Oil on the Brain

LISA MARGONELLI

Ever wonder why it costs so much to gas up your Escalade? *Oil on the Brain* traces the fuel's journey—physical, political, and economic—from its sources in trouble spots like Venezuela and Iran, on traffic-choked streets in China, at the top-secret strategic petroleum reserve on the Gulf Coast, in the capitalist hum of the Nymex trading floor, through smoky Southern California refineries, and on to a local service station in San Francisco. Along the way, truck drivers, rig workers, and petroleum engineers put a human face on your sticker shock. —Mathew Honan



Final Impact

JOHN BIRMINGHAM

This third and final installment in Birmingham's insanely clever alt.history mashup of WWII and the 21st-century war on terror isn't your typical time-traveling techno-thriller. For one, an aircraft carrier from AD 2021 is named the USS *Hillary Clinton*, after "the most uncompromising wartime president in the history of the United States," and when multicultural troops from the future join with their '40s counterparts to fight fascism (again), the Greatest Generation reacts violently to serving alongside women and blacks. —Mark Horowitz

Play | Print



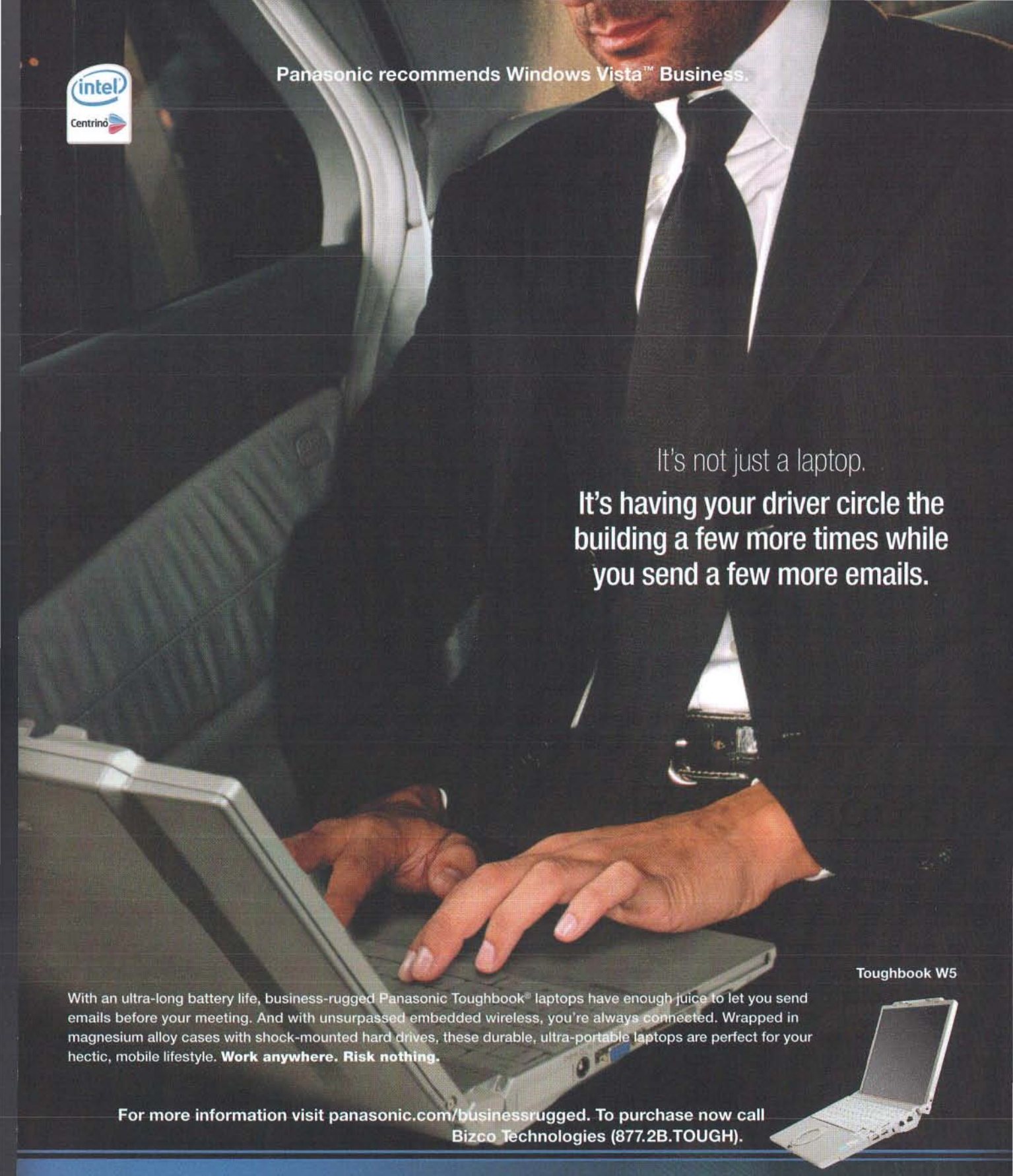
And Sci-Fi for All ...

Who says sci-fi fantasy is kids' stuff? Well, lots of critics, to start. But thank J.K. Rowling for bridging the genre's generation gap. Since the first Harry Potter hit the stands in 1997, Neil Gaiman, Michael Chabon, and other luminaries have written books aimed directly at kids ... and found that adults kinda like 'em, too.

The latest example is British fantasy writer China Miéville, whose *Un Lun Dun* follows a young girl's quest to save a creepy parallel-universe London. And for Miéville, best known for a steampunk trilogy full of superhot, beetle-headed women and nightmare-eating monsters, it's a new direction. He's written something that kids, especially young girls, will devour.

Mieville's early work had a problem endemic to modern sci-fi—it's a lousy gateway drug, strictly for those who've already acquired a taste for it. But taking Rowling's lead, *Un Lun Dun* gets back to basics: quests, magic, monsters (with a dash of 21st-century irony). Gaiman's 2002 young-adult fantasy, *Coraline*, had that kind of universal appeal, too, and his next book, *InterWorld*, out in June, looks to target the same audience. More evidence of the genre's age-neutral popularity: marquee movie treatment. Christopher Paolini's *Eragon* hit theaters in December, and the screen adaptation of Philip Pullman's *The Golden Compass* is due this year.

Un Lun Dun isn't perfect; it often mistakes wordplay for imagery and feels a little pat. But give it to a kid (and borrow it when they're done). It just might help them grow up into the kind of nerd we need a lot more of—one who thinks they can save the world with sheer ingenuity. —ADAM ROGERS



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Next-Gen Smackdown

Sony's PS3 features heavyweight processing power, while Nintendo's Wii is half the size and half the cost, but has only flyweight graphic abilities. Here's a look at the pros and cons of each console. —CHRIS BAKER



Nintendo Wii

The first thing you notice is the compact, innovative design—the tiny console is about the size of three DVD cases. The remote-shaped controller features a built-in speaker, force feedback, infrared transmitters, and gyroscopes that are opening up whole new avenues of gameplay. But the graphics on launch titles are downright janky—comparable to the Gamecube at best.

WIRED It's almost impossible to convey the enormous promise of the "Wii-mote" controller. You have to experience it. Downloadable versions of classic Nintendo games are our kind of killer apps. And like the high-end PS3 we tested, it ships with Wi-Fi functionality.

TIRED No game developer has really unlocked the potential of the Wii-mote. Low price seems less of a bargain when you consider the lower-tech specs and the absence of DVD playback. No online multiplayer with launch titles.

$250, www.nintendo.com

Sony PlayStation 3

Blu-ray movies really do look markedly better than standard-definition, and game developers may eventually find a way to use scads of processing power and much bigger Blu-ray discs to deliver experiences that no other console can. But despite all the talk of "the first console with true 1080p resolution," the PS3's launch games look no better than the Xbox 360's. Plus it has a ludicrously high price tag, tons of extra DRM, and a far less robust online service. How do you say "boondoggle" in Japanese?

WIRED Sleek interface. Wireless joypad is comfortable and light. Doubles as Blu-ray player.

TIRED 11-pound leviathan sucks up to 380 watts while running a game (versus 203 watts for Xbox 360 and 53 watts for Wii) and pumps out enough heat to turn our test lab into a sauna. Joypad lacks force feedback, which is sorely missed.

$599, www.playstation.com

How We Tested

- **GAMEPLAY** Spent two dozen hours with key launch titles and played 8 to 10 other games on each console.
- **FORMATS** Used both a standard TV and hi-def widescreen to assess compatibility with different resolutions.
- **CONNECTIVITY** Tested PlayStation 3 online over an Ethernet connection, and Wii online via a USB dongle ($30) that links to a PC over Wi-Fi.

LOST PLANET™

EXTREME CONDITION



"...it simply rocks."
–Game Informer

"...plays like a dream..."
–Games Radar

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–GameSpot

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–IGN

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–Play

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–GamePro

"...one lean, mean, addictive futuristic shootin' machine."
–Official Xbox Magazine



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STEELBOOK

XBOX LIVE

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Weather Beaters

The latest rage in performance outerwear is a jacket that's windproof and waterproof like a traditional shell but that moves and stretches with you through all your adventures. The best can replace your classic combo of a ratty old fleece and a spendy Gore-Tex jacket. —MARK MCCLUSKY



Mountain Hardwear Synchro Jacket

WIRED Slim cut and light weight help you forget you're even wearing a coat. Every other jacket on the planet should steal this elegant cuff design.

TIRED Exterior taped seams covered with rubberized material that frankly looks a little odd. Overly tight zippers on pockets take a lot of effort to slide.

$185, www.mountainhardwear.com

Outdoor Research Logic Jacket

WIRED Terrific value: Laser-cut seams, clean construction, dual-opening front zipper, and good performance for a song. Chest pocket keeps MP3 players safe and cozy.

TIRED Unexciting styling. Slightly boxy fit makes jacket seem bulkier than it actually is. Not completely waterproof. Lack of fabric pulls on pocket zippers makes them difficult to open.

$99, www.orgear.com

Salomon Sonic Shield Jacket

WIRED Thoughtful features for skiers and snowboarders, including a built-in powder skirt and a chest pocket that holds an included wipe for goggles and glasses. Pit zips let you vent excess heat. Best waterproof performance of the bunch.

TIRED Hood is great when you need it but gets in the way when you don't. Expensive, especially given its specialty nature. Loose threads and other minor construction faults.

$450, www.salomonoutdoor.com

Marmot Sharp Point Jacket

WIRED Gore WindStopper fabric a solid performer in all situations. Large pit zips provide great ventilation as you heat up. Reinforced shoulders and elbows protect against wear and tear.

TIRED Performance doesn't live up to premium price. Size L cut more like an XL; try it on before you buy. Not quite as stretchy or flexible as other models.

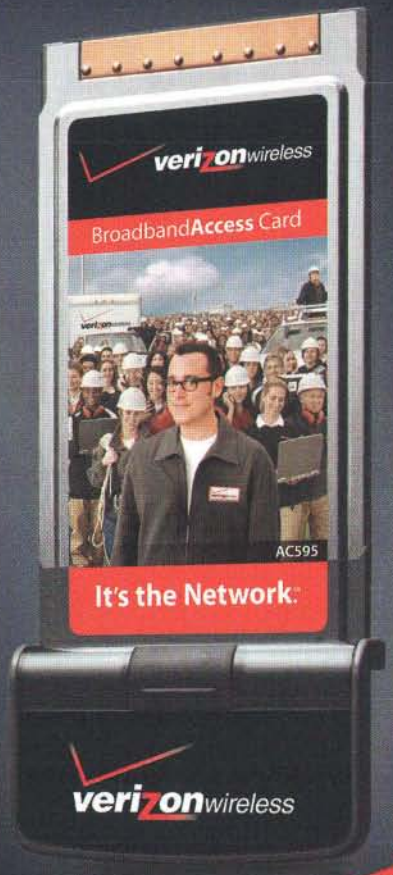
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Office Party

The ever-expanding array of iPod-dock speakers gets all the press, but most of these all-in-one systems can kick out the jams harder and better. All play CDs, and some handle MP3s and video. And they look supercool sitting on a bookshelf or desk in your office, den, or dorm room. —EVAN SHAMOON



JVC EX-A10

Minisystems tend to feature plastic boxes, but this gorgeous desktop model flaunts cherrywood speakers with sake-soaked birch woofers and tweeters. The whole package plays as good as it looks. Acoustic music, in particular, sounds remarkably natural. Besides audio CDs and DVDs, the system fires high-quality DVD and DivX video from its component outputs.

WIRED Beautiful design—could be the nicest piece in your living room. Plays almost every disc format known to man.

TIRED No HDMI video output. Subwoofer not included—for a thousand bucks you'd expect rafter-shaking bass.

$1,000, www.jvc.com



Sony CMT-DX2D

If shelf space is at a premium, this rig's tiny (21 x 12-inch) footprint should do the trick. For two hundred bucks, the CMT-DX2D pumps out 100 watts of sound from standard and MP3 CDs and doubles as a progressive-scan DVD player. It may not be enough for block-rocking beats, but with crisp and clear output at low volumes, it's more than enough to pump up your desk.

WIRED Compact, smartly designed box with uncluttered face. Features AM/FM radio and—get this—it plays cassettes!

TIRED What good is a progressive-scan DVD player when the system lacks HDMI video outputs? No front audio inputs.

$200, www.sony.com



Sharp XL-UH260

A USB connection provides access via remote control to iPods and other digital audio players. Unfortunately, you have to scroll through playlists one track at a time—not unlike bowling with your eyes closed. Score that a near-miss on iPod connectivity, somewhat made up for by the low sticker price, programmable five-disc changer, and AM/FM radio.

WIRED Versatile sound from six-mode equalizer. Disc changer plays many formats, including MP3 and WMA CDs.

TIRED MP3 integration is more trouble than it's worth. Looks and feels a bit cheap.

$150, www.sharpusa.com



Philips MC235

High-design looks belie this package's low price. Less than 4 inches deep, it won't crowd your space—particularly if mounted on a wall with the included hardware. Here's the catch: The system puts out a puny 10 watts, making it adequate for the bedroom or office but unsuitable for the living room.

WIRED Six sound settings moderately enhance the modest audio output. Cool auto-sliding CD door mechanism.

TIRED Despite a dynamic bass boost mode, the low end is feeble—not a system for spur-of-the-moment dance parties. With no front inputs, this unit isn't iPod-friendly.

$100, www.philips.com

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Talk Is Cheap

With call quality improving and prices dropping, you really can ditch your landline and rely on the Internet for all your gabbing needs. Plus, VoIP often comes with lots of extra features, like Web-based voicemail and the ability to take your phone number anywhere you go, worldwide. —JEFF BERTOLUCCI

Vonage

Sure, the company's commercials grate, but give Vonage its due: It's the best VoIP service available. For $25 a month, you get unlimited calls to the US, Canada, and a chunk of western Europe. Setup is quick and painless—five minutes, tops—and call quality is clear even while you're downloading video. Plus, the numerous dialing features—everything from three-way calling to call return—should satisfy even the highest-maintenance dialers.

WIRED Lets you adjust sound quality to preserve bandwidth. Free international calls to other Vonage users. Seven-digit dialing available for local calls.

TIRED Residential fax line costs an additional $10 per month.

$25 per month, www.vonage.com

AT&T CallVantage

AT&T's VoIP service provides top-notch voice quality and free faxing—once you get it to work. During our test, we couldn't find a dial tone, and an AT&T support rep had to email us a firmware upgrade. The patch worked—but this may be more effort than you're willing to put into a phone.

WIRED Well-organized Web site makes it easy to set options like caller ID, call waiting, and call forwarding. Locate Me feature rings up to five numbers until someone picks up.

TIRED Basic unlimited calling plan excludes Europe.

$25 per month, www.callvantage.att.com

8X8 Packet8

The price is low and the calls are clear—exactly what VoIP service should be. Packet8 charges a rock-bottom monthly fee, yet offers call quality on par with tonier services. One complaint: The poorly organized Web site requires users to drill through several screens in order to change basic settings like voicemail and caller ID.

WIRED No setup snags, no dropped calls, no echoes. Seven-digit dialing on local calls. Optional videophone service ($200 per phone) for chatting face-to-face with others in Packet8's posse.

TIRED Some problems logging into Packet8 site. Long hold times for phone support. Basic unlimited calling plan omits Europe.

$20 per month, www.packet8.net

SunRocket

You've gotta love a scrappy startup, particularly one that sells a year of unlimited calls to the US and Canada for $199, taxes included. But wait, there's more: SunRocket throws in a second line for incoming calls only—handy for routing telemarketers and annoying relatives directly to voicemail. One glitch: The line went dead a couple of times, but a simple reboot of the adapter produced a dial tone.

WIRED Loud, clear calls. Healthy mix of phone features—caller ID with name, call-waiting ID, and call forwarding. Seven-digit dialing for local calls.

TIRED Faxing not 100 percent reliable. If you don't opt for an annual plan, the price goes way up ($25 per month).

$199 per year, www.sunrocket.com

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Reservoir Logs

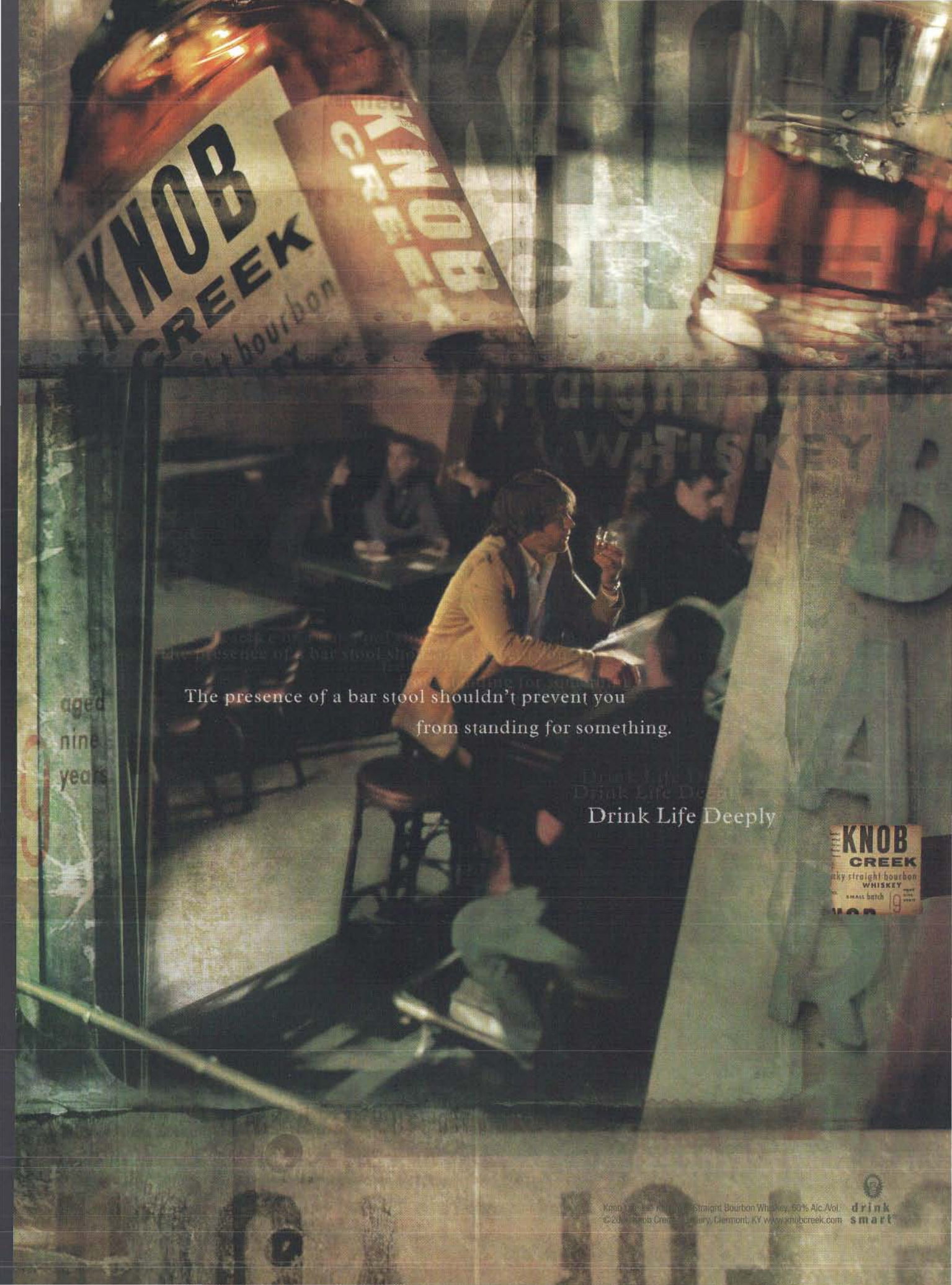
A submersible robot called the Sawfish can harvest healthy timber from long-forgotten underwater forests. Clear-cutting never looked so green.

BY MICHAEL BEHAR

I'm standing on a steel barge in the center of Ootsa Lake, a 154-square-mile reservoir in northwestern British Columbia. A chafing wind blows from the west, where the snowy, nearly treeless slopes of the Kitimat Range vanish into overcast skies. I jump as a voice booms over the outdoor PA system: "Clear to cut!" A few seconds later, a massive spruce tree erupts from the murky water. ¶ Two hundred feet below, a remotely operated vehicle dubbed the Sawfish is wielding a 54-inch-long chain saw. On the deck of the barge, an operator sits inside a cramped, dimly lit control room made from a shipping container. He's maneuvering the Sawfish with a joystick, and his eyes are locked on a video feed of footage from eight underwater cameras embedded in the contraption. A generator delivers power to the sub through a 720-foot-long high-voltage cable that also encloses a set of fiber-optic lines to transmit guidance commands from the pilot.

If you're on the shoreline or live nearby, underwater timber harvesting is remarkably quiet: no screaming chain saws or

ILLUSTRATIONS BY Kevin Hand


KNOB
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bourbon
aged
nine
years
The presence of a bar stool shouldn't prevent you
from standing for something.
Drink Life Deeply
KNOB
CREEK
WHISKEY
SMALL batch
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smoke-belching heavy machinery. In a steady, splashing procession, tree after tree bobs to the surface, where a small tugboat rigged with a pair of hydraulic claws grabs the trunks and tows them into something called a bunk, a partly submerged U-shaped cradle. I can see three bunks from the barge. Each stores up to 300 trees and can be raised onto a second transport barge that holds up to 1,000 logs. The Sawfish and its four-person crew will fill it in just four days.

to make good financial sense. Operated by just one person, a so-called feller buncher—the fastest and cheapest way to harvest timber on land—can cut at least 500 trees a day. But then it takes an additional three-member crew up to three weeks to trim and load the trees for transport. A single Sawfish is more efficient. It may clear only 250 trees in an eight-hour shift with four crew members, but there's no need to skid the logs down a hillside and truck them to a mill. Instead, a barge delivers

The forests are preserved in a kind of suspended animation. In the cold, dark, oxygen-poor water, the wood won't decay for thousands of years.

This unusual harvesting method is made possible by a submersible that can probe the deepest reservoirs for underwater trees to cut and deliver to the surface. It was developed by Chris Godsall, the 38-year-old founder and CEO of Triton Logging. The company is based near Victoria, but the principal underwater logging operation is at Ootsa Lake, almost 750 miles to the north. The lake was formed in 1954, when Alcan, the world's second-largest aluminum producer, built a hydroelectric dam here to power its smelter. The water behind the dam flooded millions of lodgepole pine, spruce, Douglas fir, and hemlock trees, leaving some $1.2 billion worth of timber preserved in a kind of suspended animation. In the cold, dark, oxygen-poor water, tree wood won't decay for thousands of years. And Ootsa is one of 45,000 spots around the globe where dams have inundated valleys and submerged vast forests. By some estimates, there is $50 billion worth of marketable timber at the bottom of these man-made lakes. Godsall is quick to point out that he has the only technology able to retrieve it.

To gather up a few logs, it might seem like lunacy to deploy the same kind of sophisticated and pricey ROVs used to explore the *Titanic* or investigate 9,000-foot-deep geothermal vents along the mid-Atlantic seafloor. But do the math and Godsall's method starts to make good financial sense. Operated by just one person, a so-called feller buncher—the fastest and cheapest way to harvest timber on land—can cut at least 500 trees a day. But then it takes an additional three-member crew up to three weeks to trim and load the trees for transport. A single Sawfish is more efficient. It may clear only 250 trees in an eight-hour shift with four crew members, but there's no need to skid the logs down a hillside and truck them to a mill. Instead, a barge delivers the trees to the mill faster and more cheaply, and because they've been submerged they're generally already stripped of foliage and bark. A Sawfish, including the control room, tool shop, and power generator, costs $800,000 to $1 million, depending on the gadgetry packed into the ROV. That's significantly less than the onetime equipment cost of roughly $1.5 million needed to run a comparable feller buncher operation. Add up all the numbers and, while conventional harvesting costs about $50 per cubic meter of wood, Peter Keyes, an executive at a global timber wholesaler and marketer, estimates Godsall's cost at closer to $40. "Sure, there are big R&D costs to pay down," Keyes says. "But the technology has given Godsall access to all these trees as if they were on land. It's like finding a new penny."

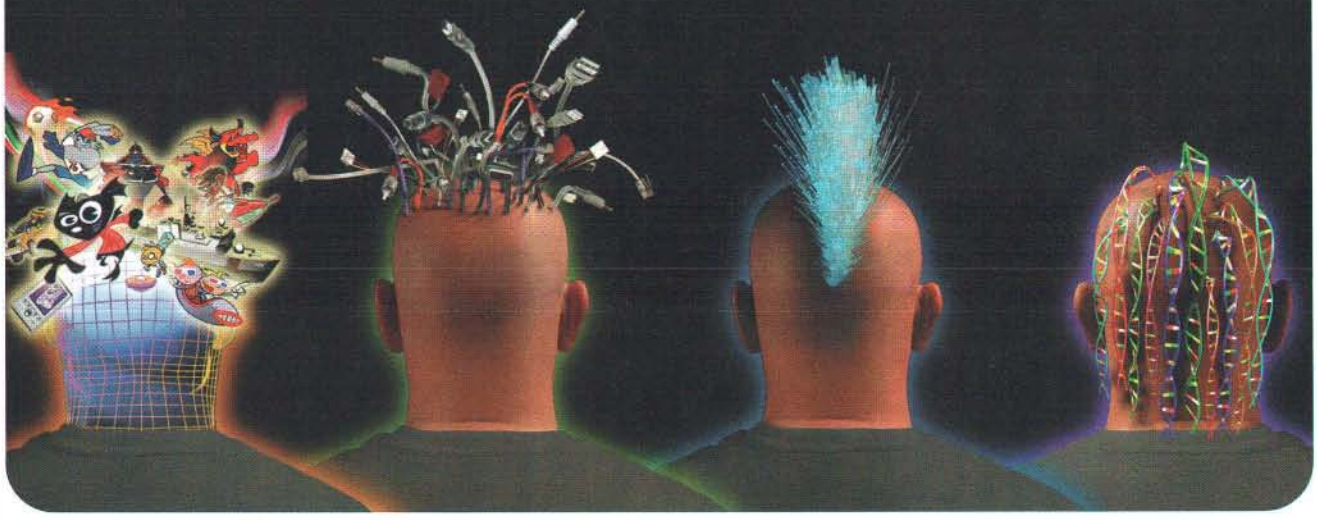
There are environmental advantages to the Sawfish method as well. Conventional aboveground harvesting contributes to deforestation, a cause of global warming that's responsible for the release of 25 percent of the world's CO_2 emissions. But because underwater trees are already dead, cutting them down doesn't worsen the situation. And with underwater logging, there are no unsightly clear-cuts and no spotted owls to worry about.

I first meet Godsall when he arrives at my motel in Burns Lake, a soggy, desolate logging outpost about a two-hour drive from Ootsa. Tall and lean, with neatly combed brown hair, he's wearing tennis shoes, faded jeans, and a blue windbreaker. Later, as we drive through dense forestlands in his rented sedan, Godsall tells me how he got interested in trees. Nine years ago, while working as a marketing consultant in Toronto, he took on a client in the log salvage business. Wet Wood Underwater Fibre Recovery employed loggers to search riverbeds and shallow lakes for sunken timber with potential market value. Eventually, Godsall signed on with Wet Wood full-time as general manager. He soon realized that hunting for a log here and there wasn't exactly the way to rake in the dough. It was akin to collecting soda cans for the five cent return deposit—profit margins were slim, and the work was tedious and time-consuming. Also, it could be unpopular with the public because scouring lake beds can upset ecosystems, churning up silt and debris that then threaten fish and wildlife.

One day during a meeting, a client showed Godsall an image of an underwater forest at the bottom of a reservoir. "I had become so obsessed with retrieving lost logs that the picture of a whole forest of trees underwater seemed at once surreal, obscene, and too good to be true. I was convinced it was trick photography." But the photo was genuine, and a few weeks later Godsall approached his bosses with a question: "Why are we hunting for sunken logs when there are entire forests waiting to be reclaimed?" Godsall suggested they build technology to go after all the standing underwater timber in the world. Everyone just laughed. Godsall resigned two days later, and in May 2000 he launched Triton.

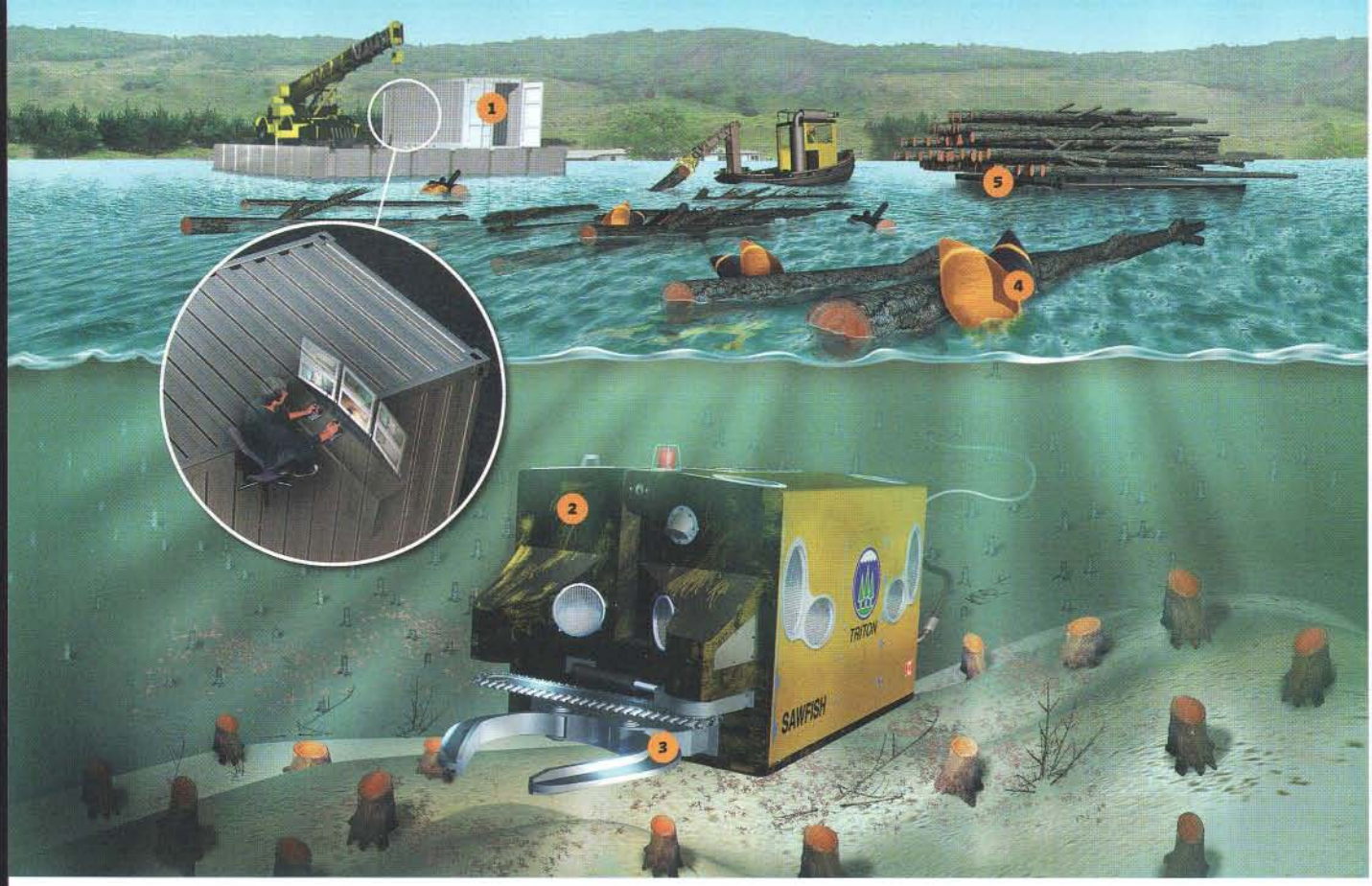
Godsall is from a clan of overachievers—his father, he says, is a "compulsive entrepreneur"; his mother, an "extremely creative" art gallery owner. One brother is a Hollywood director; another battles infectious diseases in Africa. But building a new, unproven technology from scratch made him nervous. "I am not an engineer," he admits. "It was one thing to have a good idea, quite another to execute it." He assembled a design team from a cross-section of fields, including commercial aviation, undersea exploration, and marine

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biology—there was even an engineer from the Woods Hole Oceanographic Institution in Massachusetts.

During his years as a consultant, Godsall had seen all sorts of contraptions and schemes for retrieving sunken logs—submersible cranes, scuba divers with pneumatic chain saws, and a "tree mower" that was dragged like a straight razor along shallow lake beds. Most didn't work, some were extremely dangerous, and very few could go much deeper than 60 feet. But Godsall knew that in Ootsa, nearly three-quarters of the good timber is more than 60 feet below the surface. "We had to make that our territory," he says.

The team needed to invent something totally new—like the Sawfish. About the size of a VW bus and painted bright yellow, the sub can dive to 1,100 feet—deeper than any reservoir on earth—and fell a tree in two seconds. Besides advanced video imaging, sonar, and GPS capabilities, the ROV has a 75-horsepower engine and seven directional thrusters, making it extremely agile. And the vehicle is robust enough to withstand an errant tree toppling on it underwater. The Sawfish has a set of 52-inch-long lobster-like steel pincers used to attach the ROV to the base of a tree while cutting. A powerful waterproof chain saw, mounted on a hinged mechanical arm, can slash through trunks up to 8 feet wide.

Perhaps the most ingenious innovation, though, is Godsall's solution for bringing trees to the surface. Underwater timber is waterlogged and doesn't float. So the Sawfish attaches airbags to each tree before cutting it. Using a mouse, keypad, and joystick, a remote pilot can load an airbag on a chain-driven conveyer belt located inside the belly of the Sawfish, then engage a hydraulic ratchet that ejects the bag, screws it onto a tree trunk, and fills it with 5 cubic feet of air. After the log floats to the surface, a tugboat drags it into a storage bunk, and a crew mem-

Up From the Deep

Piloted by a joystick jockey at the surface of the water, the Sawfish can cut 250 trees in eight hours.

1) COMMAND AND CONTROL
Lowered into the water by a crane, the sub connects to a diesel generator on the surface with a 720-foot cord. Inside a container on the barge, a pilot **(INSET)** scans video from eight underwater cameras and maneuvers the Sawfish with a joystick.

2) ROAM
The ROV has a 75-HP engine and seven directional thrusters, allowing it to move safely through treacherous terrain.

3) CUT
To fell a tree, the Sawfish clasps the trunk with its steel pincers so its 54-inch chain saw can rip through the wood.

4) RETRIEVE
Waterlogged wood doesn't float, so the Sawfish screws airbags into the tree trunks using a hydraulic ratchet. The buoyant bags raise the trunks to the surface.

5) STORE
A tugboat rigged with a pair of hydraulic claws drags cut logs onto one of several floating storage bunks.

ber removes the reusable bag. The Sawfish can deploy up to 50 airbags before engineers have to raise it for a refill.

In August 2002, preparing for its maiden voyage, Triton engineers loaded the Sawfish onto the back of a semi and hauled the sub 14 hours to Ootsa Lake. "We cut the first tree and everybody cheered," Godsall recalls. "We cut another tree and everybody cheered. Then we cut a third tree and the Sawfish broke and everybody went home." There were other setbacks—airbags exploded, the Sawfish got its tether lines wrapped around branches—but Godsall persisted. To work out the kinks, he raised more money (for a total of roughly $1.2 million) and built a floating R&D lab on a reservoir near Triton's headquarters.

Triton now operates two Sawfish vehicles on Ootsa Lake, and Godsall plans to build 10 more. He aims to harvest 45,000 trees a year in Ootsa Lake and hundreds of thousands more in other reservoirs. The timing is perfect: Demand for decks, hardwood floors, and roofs crafted from sustainable timber is increasing. Just as organic food swept into grocery stores in the 1990s, Godsall is planning to line the lumber aisles of Home Depot and Lowe's with underwater-harvested timber. He's also talking to Ikea about an exclusive deal to provide wood for tables and chairs. And the Triton logo is becoming an "Intel Inside"-type seal that retailers can slap on products to attract green-minded buyers. A study by the Forest Stewardship Council, a nonprofit based in Germany, says the market for so-called good wood, which includes underwater logs, grew 25 percent in each of the previous two years to hit $5 billion in 2005.

Godsall is also eager to expand operations beyond Canada. He recently met with reservoir managers in the US, Australia, South America, Africa, and Southeast Asia to broker additional deals. One project involves clearing trees from the bottom of Volta Lake in Ghana, where seasonal drops in the water level bring submerged timber dangerously close to the surface. Trees have punctured holes in boats and passenger ferries sinking them and killing hundreds of people in the past four years alone.

Most salvage loggers believe that reservoirs conceal 200 million to 300 million trees worldwide. "That's a low estimate," Godsall says. "We're continually discovering reservoirs with trees in them. There's one in Brazil called Tucurui with $1 billion worth of timber." Eastern Europe is another untapped frontier: "It has the largest reservoirs with the most trees." But pinpointing underwater forests is tricky. Godsall's team studies old maps that show where forests once stood. They also use specialized sonar to verify the existence of trees and underwater cameras to identify the variety—spruce, pine, fir, or rare hardwoods such as teak and ebony. Some species are more valuable than others, and Godsall wants the sticks that will bring in the most money.

To snag the best logs, Godsall hires people who know trees and can make snap decisions about wood quality based on a quick scan of underwater camera footage. Take Josh Chernov, a marine biologist and one of Triton's five pilots. He's inside the Sawfish's control room atop the barge, watching six LCD panels relay video from the submerged cameras. Sitting in a *Star Trek*-style captain's chair, he uses a joystick to zoom around a stand of valuable lodgepole pines at the bottom of Ootsa Lake, ignoring nearby timber of lesser value. There's a muffled whir in the corner from the 2.8-GHz off-the-shelf Wintel PC—that's the Sawfish brain. Chernov clicks a button on the joystick to toggle between video feeds, panning a front-mounted camera across the lake bed. The scene is eerie: A lost forest beckons from the shadowy depths, ancient giants still standing proud in the 46-degree-Fahrenheit water.

At the moment, however, Chernov is about to slice through the 3-foot-wide trunk of a lodgepole pine. He deftly glides the Sawfish to the base of the tree, where it hovers a few feet above the lake bed before clasping onto the trunk with its pincers. While the Sawfish clutches the tree, Chernov switches to a different camera, this time with a view from behind the hydraulic airbag ratchet. From this angle, I can see a column of fluorescent airbags stacked single file in a storage compartment. Another click on the joystick and the ratchet telescopes forward, snagging an airbag, bolting it to the tree, then inflating it.

> Just as I step out of the control room and onto the deck, a log bursts through the surface. It's a little like watching rockets take off.

He radios over the PA: "Clear to cut?"

"Roger, clear to cut," a deckhand calls.

Chernov starts the chain saw, which swings out from inside the nose cone of the Sawfish and slices through the trunk in seconds. Because the airbag is affixed to the base of the trunk, the tree inverts 180 degrees before beginning its ascent. I step out of the control room and onto the deck just as it bursts through the surface of the water. "It's kind of like watching the Apollo rockets go up," says Dave Menzies, a Sawfish operator who spent 20 years as a pilot for a commuter airline before joining Triton. Moments later, another log appears, then another. There is enough timber in Ootsa Lake to keep the Sawfish busy for 50 years—and plenty more lumber in Panama, Malaysia, and other countries where Godsall hopes to begin harvesting by 2008.

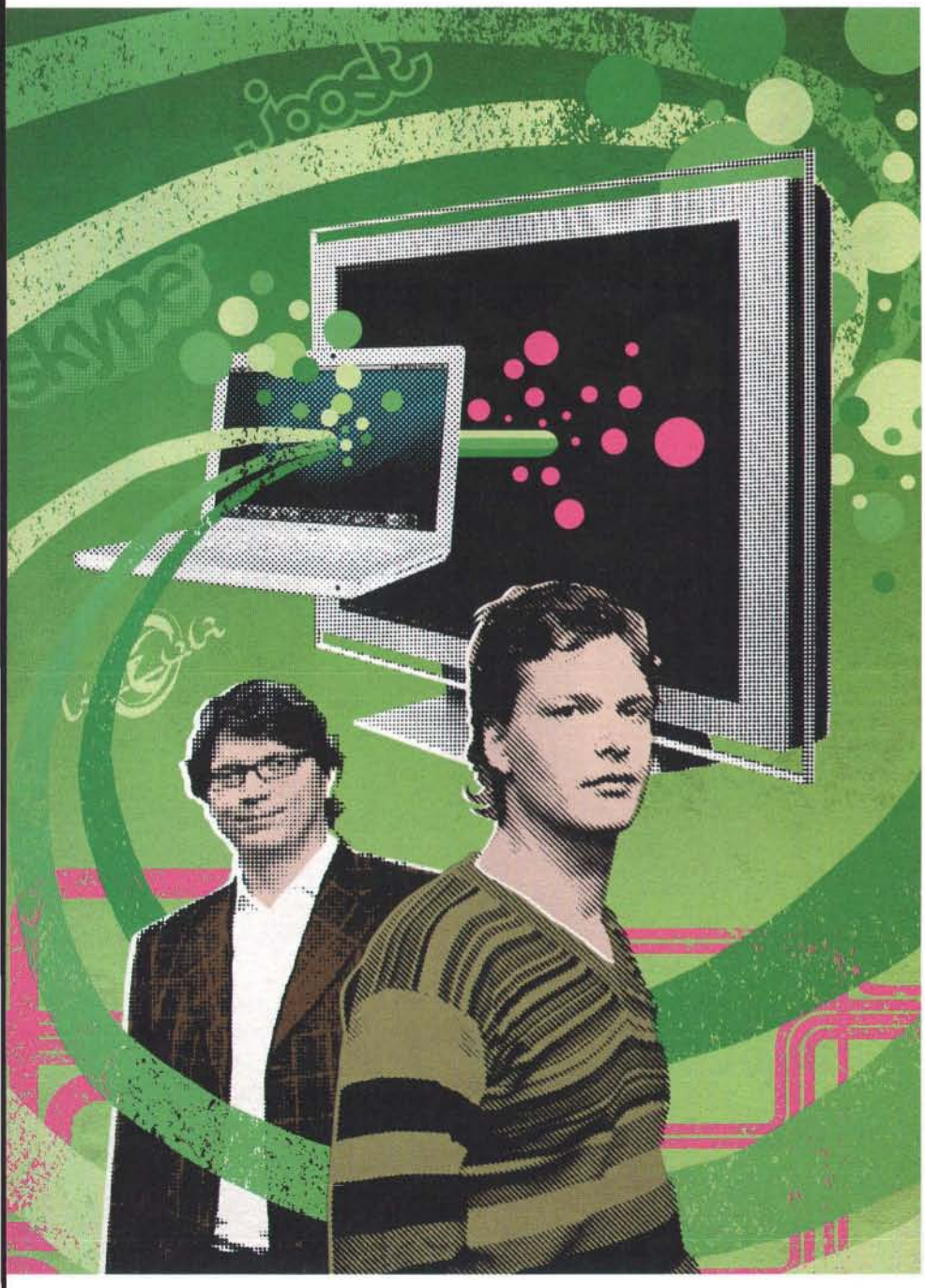
"Mother Nature never intended for trees to be underwater," Godsall says. But that's where forest after forest has ended up. He still marvels at the perfect preservation of the submerged trees. Just waiting, he says, to be harvested guilt free and for profit, by the Sawfish.

MICHAEL BEHAR (michael@michaelbehar.com) *wrote about wildfire computer simulations in issue 12.10.*

Here Comes Trouble

First they Kazaa'd the music industry. Then they Skyped the telcos. Now Janus Friis and Niklas Zennström want to Joost your TV. (That's a good thing.)

BY SPENCER REISS



In a 10th-floor office a few block south of New York's Union Square, gangly Janus Friis folds himself into an undersize chair. He's here from London for a couple of days, toting a ThinkPad with demo aboard. A little white sticker on the machine's lid reads in retro-shiny silver letters: THE VENICE PROJECT.

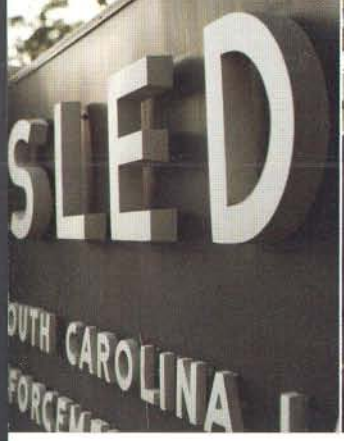
Friis, 30, is half of the most feared digital tag team since Google's Sergey Brin and Larry Page marched across the Net. He's the visionary, a shy Dane in beat-up jeans and loud shirts. Niklas Zennström, an amiable 40-year-old Swede, wears the suit. Together, the pair has spent the past six years bit-bombing the Net's biggest and most vulnerable targets. Kazaa, their free file-sharing network, mushroomed amid the wreckage of the original Napster; it was managing 3 million downloads a month in 2001 when entertainment industry lawyers moved in. Next they built Skype, the free voice-over-IP telephone system, and sold it to eBay just over a year ago for $2.6 billion. That figure alone guarantees that their calls get returned.

In a little conference room tucked behind a bull pen bustling with new hires, Friis flips

Zennström (left) and Friis say they've taken "the best about TV and added the best from the Internet."

PHOTOGRAPHS BY MORAD BOUCHAKOUR

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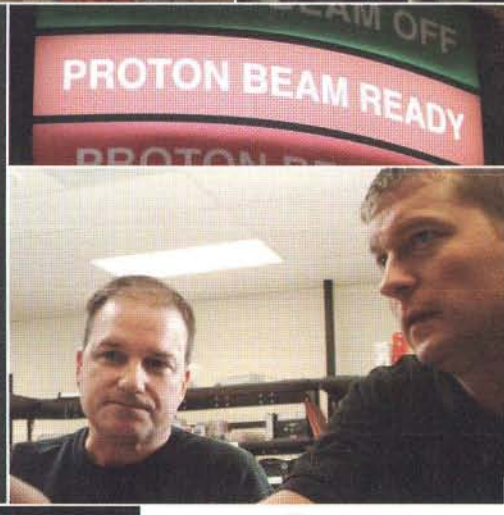
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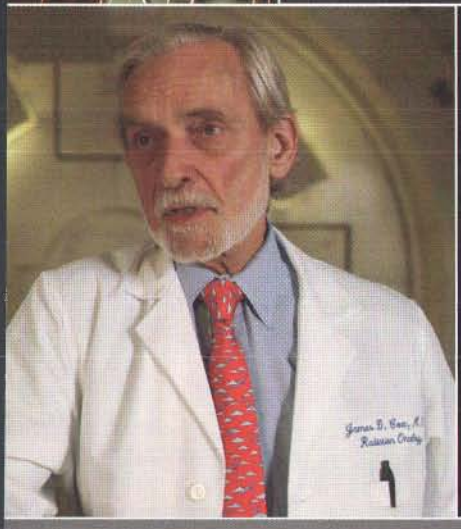






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open the laptop. He pokes a few keys, locates a Wi-Fi network, hits a few more keys. Then, with a final click and the slightest little smile, he spins the machine around and ... how about that: a Red Hot Chili Peppers concert, running full-screen. Another click. Razor-sharp footage of pandas munching shimmering stalks of bamboo. Click. *Fear Factor*, back from the grave. Click. *Earth: Final Conflict*. Click. *Rocky and Bullwinkle*.

Laptop TV! Not to mention desktop and palmtop. "It even looks pretty good hooked up to my plasma," Friis says. How do you say *touché* in Danish?

But he's not finished. A flick of the cursor brings up a see-through virtual remote control with buttons for Play, Stop, Skip, and Reverse—plus something novel: a box labeled Search. An icon at screen left opens a translucent program guide that lists Indy Racing, Warner Music, National Geographic, and other attractions interlaced with personalized "smart channels." How many? "Basically, it's infinite," Friis says. Another click opens a palette of widgets straight out of a late-model online social network: buddy list, IM, and options to "Rate It!" and "Share What I'm Watching!" Then up to the top for a window labeled Content Owner's Area. "We're still working on that."

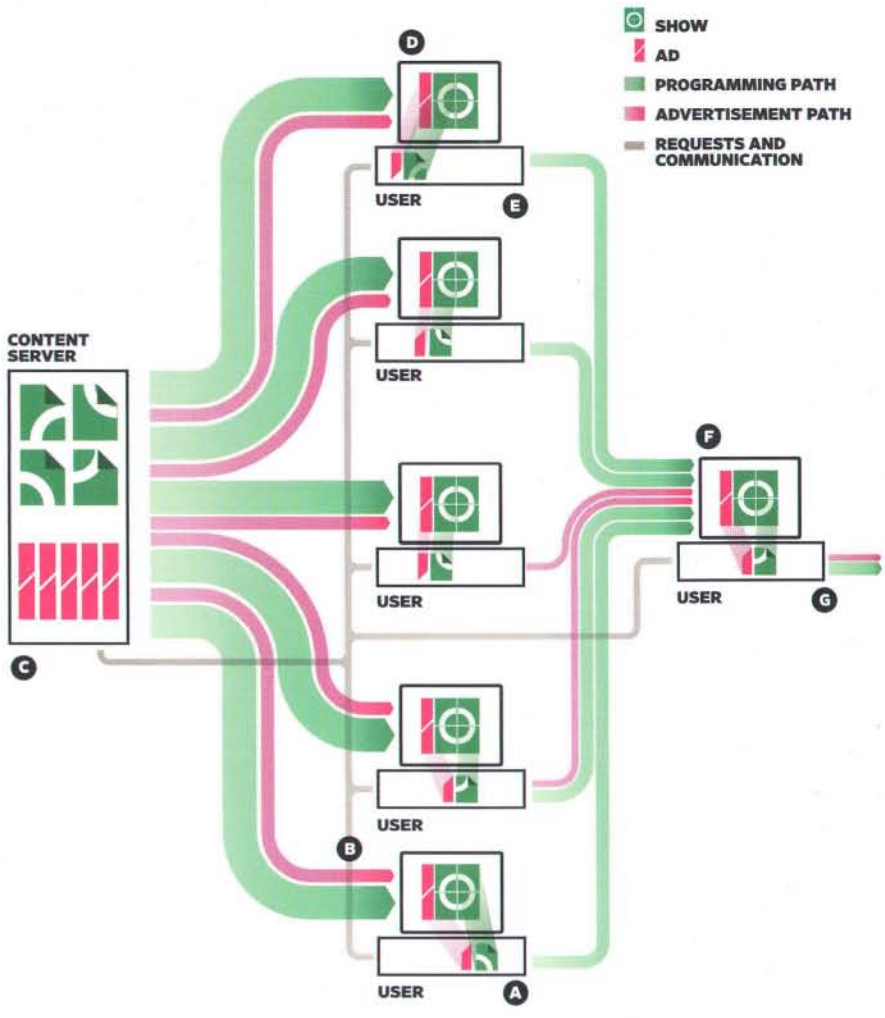
"Pretty cool, yes?" he asks.

Yes.

Somewhere between amazing greatness and raving geek fantasies of world domination lives the Venice Project—or Joost, as it is expected to be rechristened by the time you read this. Zennström and Friis have day jobs as Skype's CEO and executive vice president of innovation, respectively. But in the cute way that Internet billionaires can do whatever the hell they want, they're teeing up the mother of all side projects. "It's really pretty simple," Friis says, shifting into mantra mode. "We've taken the best things about television and added the best things from the Internet."

In just over a year, the pair has roped together a crew of roughly 150 people, including the former chair of the Apache Software Foundation and MTV Networks' ex-global marketing honcho. About half are engineers and developers—a *Star Wars* bar scene of Nethead talent from IBM to Ubuntu—based in a five-story building in Leiden, the Netherlands, just south of the Amsterdam airport. Front offices in New York and London are busily forging ad and content deals. Server central will be in Luxembourg, home base of Skype's planetary phone network, with mirrors in Europe, Asia, and North America. The whole thing will run on the same proprietary Estonian-built code that keeps Skype's 136 million worldwide users chattering happily.

The vision: universal TV, running on a hybrid P2P platform—millions of exquisitely networked PCs fortified with traditional video servers. Free to viewers who download the player app. Friendly to content owners, thanks to industrial-strength encryption. Delightful to advertisers, adding pinpoint targeting to their all-time



The Television Will Be Revolutionized

How Joost's hybrid peer-to-peer system works.

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CHART BY Arno Ghelfi

favorite medium. Everyone's a winner!

There are a million reasons to think this is nuts, starting with the fact that television executives haven't exactly been eager to float their treasures on the pirate-infested waters of the Internet. There's also the little matter of competition—checked GooTube's bank account lately? And the cable and satellite guys might take exception to having their cash cows filleted. Then there are the TV moguls, who are scrambling to set up their own Web channels and quietly discussing the possibility of a joint, industry-sanctioned YouTube killer. Why should they hand the keys to their limos to a couple of guys who were dodging subpoenas as recently as last summer?

Silicon Valley has an old saying: Don't bet against the Internet. To which Zennström and Friis clearly hope to add a Scandinavian corollary, with roots going back all the way to the Middle Ages: Don't bet against the Vikings.

Like a lot of major-league geeks, Dirk-Willem van Gulik doesn't pretend to be a fan of television, at least in its traditional incarnation. His vice is Lego. But the Venice Project's chief technical architect also knows as much as anyone about megaweight bitstreams. He made his name figuring out how to transmit large scientific data files, and he's a long-standing director and former president of the foundation that supports open source Apache software, the world's most popular Web server. He's very clear about the economic folly of using big servers to mainline video to millions of desktops. "You can try to cut costs by allowing only crappy little images. You can limit the run times or make money selling hardware. But eventually the bandwidth bills will eat you alive. YouTube, iTunes, and the rest of them haven't got a chance. We just hope they take their time realizing it."

Arguments rage in tech circles about whether Moore's law will someday make bandwidth too cheap to meter. For now, though, the most cost-effective way to move video, music, and other large files over long distances is to distribute the task among a network of users—peers, in computerspeak. Indeed, a peer-to-peer network actually gains efficiency when a howling mob of would-be viewers suddenly logs in, creating exponentially more paths for the data to follow. To date, P2P networks have been used mainly to facilitate downloading, as with Kazaa and BitTorrent. The engineers in Leiden are taking the same scheme and applying it to a different purpose: streaming video directly onto a user's screen.

Video was part of Kazaa's original spec, but pathetic turn-of-the-millennium connection speeds pushed MP3-encoded music to the head of the hit parade. Besieged by irate record and movie companies, Zennström and Friis bailed and turned their P2P guns on the fat and happy telephone industry. Skype neatly sidestepped the copyright issue. But it also demonstrated P2P's ability to stream data, in real time, on a global scale. You just need very clever code to make it work.

By the time eBay put $2.6 billion in their pockets, Zennström and Friis saw other potentially momentous pieces falling into place. Broadband—or something like it—had finally reached critical mass in the world's leading media market, the US. Led by gamers and fans of pirated movies, even nongeeks were figuring out how to hook computers to TV screens. And despite all the lawsuits, Big Media was finally coming around to viewing the Net as an opportunity, not just a threat. "The opening was there," Friis says. "Somebody needed to take it."

The Venice Project fired up in stealth mode, with Friis and Zennström writing the checks and sitting on the board, van Gulik steering the technology, and Fredrik de Wahl, a 31-year-old Swede, as CEO. By design, it was less a wiggy skunkworks than a mashup shop for existing technologies, principally open source/open standard software. Van Gulik calls it "a big exercise in systems integration." More simply: "We're snapping together Legos."

Block number one is data compression. In a heavily secured machine room in Leiden, Sun workstations crunch video that arrives on everything from Blu-ray discs to obsolete 1-inch tapes. The goal is to render DVD-quality pictures—no sudden freeze-ups or obvious artifacts—at around 400 Kbps. (On a typical 500-Kbps home connection, that leaves headroom for the vital job of

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BitTorrent	•			•	pay-per-show	*24, Chapelle Show, SpongeBob, Laguna Beach, Prison Break*
Brightcove	•	•	•	•	advertising, pay-per-show	National Geographic, Time Life, Warner Music
Google Video	•	•	•	•	pay-per-show	*CSI, Charlie Rose, Star Trek: Voyager, Macgyver, Now*
iTunes Store	•			•	pay-per-show	*Battlestar Galactica, CSI, Desperate Housewives, South Park*
Joost (the Venice Project)	•		•		advertising	*Earth: Final Conflict, Fear Factor,* Indie Racing
JumpTV	•	•	•		advertising, pay-per-show, subscriptions	Sports, news, and music from 180 networks in 60 countries
MediaZone	•	•	•	•	advertising, pay-per-show, subscriptions	Mostly sports, from 100 networks in 12 countries
Peer Impact	•	•		•	pay-per-show	*Babylon 5, Dukes of Hazzard, Flintstones, The Loop*
YouTube		•	•		none	Whatever users upload, plus a special deal with CBS

From Airwaves to Bitstreams

Companies are racing to put A-list TV on the Net.

Joost isn't the only business trying to bring the broadcast TV experience to the Internet. Even as the networks hammer out their own offerings, upstarts are cutting licensing deals to deliver streams and downloads, clips and full shows—with various plans for making a buck. Here's a quick survey of the competition. —LUCAS GRAVES

uploading to other peers.) The Leiden crew also layers in metadata—text items like alternate titles, credits, locations, foreign-language subtitles, and other search fodder. On the to-do list are user-added tags and a standardized front end that will let video producers pour their own files directly into the system.

The second piece explains the word *hybrid* in the project description. P2P networks cache content on users' hard disks as tiny fragments—in this case, 10-second video snippets. But new content has to start somewhere. Also, the system needs a server of last resort for rarely viewed material and bits that get lost in transit. Enter what van Gulik's team calls "long-tail storage": conventional servers big enough to hold 40 terabytes of programming—the equivalent of about 80,000 half-hour TV episodes, compressed for streaming. Three data centers, tied via Luxembourg to the main library in Leiden, will cover Europe, North America, and Asia, with more to be added as the user base expands.

Block three is Global Index, the P2P networking technology developed by Joltid, Zennström and Friis' Estonian software shop. Road-tested with Kazaa and Skype, Global Index orchestrates the flow of bits among potentially millions of peers and a complex skein of servers. Its big innovation is to carve a sprawling network into more manageable subnets without sacrificing P2P efficiency. Ask the engineers for details and they become studiously vague.

They're happier to talk about one final set of key components. Van Gulik estimates that 80 percent of the project's software comes from existing libraries of open source code. Engineers culled the pieces they needed and stitched them together into gnarly databases and backend servers, plus the crucial 10-Mbyte app that runs on users' PCs. "Without Mozilla, Ubuntu, and a lot of other public code," van Gulik says, "we'd still be scratching our heads."

Lego-style architecture, open standards, and public code radically reduced both the build time—the real programming work just started last June—and the complexity of melding P2P, streaming video, encryption, targeted advertising, search, and the rest. It's also an invitation for geeky users to pile in with their own plug-ins and add-ons, using the onscreen community area as a launchpad.

Now we're getting out there: user-*built* television. Why limit audience participation to uploading content? For that matter, why hem in advertisers and producers with cookie-cutter formats? It's the latest lesson of the Net: Let them come and they'll build it. "A year from now we'd love to have content owners doing all their own uploading," van Gulik says. "The same with advertising. We'll probably lose control of the community side as well." He clearly likes the idea.

Paradoxically, one thing Zennström and Friis don't particularly want is user-generated content. That's partly tactical, a way to differentiate their new baby from YouTube. But they've also learned—the hard way—about the risks of letting the audience upload protected material. Kazaa's unhappy run-in with the law ended last summer with a $115 million payout to settle copyright infringement claims going all the way back to the file-sharing service's earliest days. "We are going to be the single most legal platform on the Net," says David Clark, the New York-based advertising director, formerly with MTV Networks. "The entire ecosystem falls apart when people don't get paid."

He's not kidding about going legit. From top to bottom, Zennström and Friis are setting out a tasty smorgasbord of treats for

CHART BY Arno Ghelfi

Ads on Joost will be highly targeted: "Buy all the *Desperate Housewives* viewers in a zip code. Or the first thing a given viewer watches on a given day."

content owners. Piracy worries? Industry-grade X.509 encryption is built in. Prefer your own branded channel? Slice and dice your programming any way you like. Want to deliver hi-def? Whenever or wherever typical cable user bandwidth reaches 2 Mbps. (P2P's cost advantage over conventional streaming increases at higher bitrates.) Need to block a country where your digital rights are already spoken for? No problem. Subscriptions and pay-per-view? They're in the road map.

There's more here than just pandering to Big Media. Bigger, better content pulls bigger, better audiences. And bigger audiences make P2P networks run more efficiently. So the aim isn't to create a geek playpen, it's to migrate television's mass audience to the Web. "We want to be in the space where people are doing what they do now with TV, watching four to six hours a day," says Henrik Werdelin, 30, another MTV defector who spearheads overall product development. And he can't resist taking a little potshot: "That's a lot of YouTube clips."

To pull that off, the history of both the Internet and television suggest an obvious price point: zero. "The ultimate value of Skype is free phone calls," says Friis, who cheerfully mixes rabble-rousing populism and cold-eyed business. "The ultimate value of what we're doing here is free TV."

But the project also aims to add value to free TV in a way that only the Internet can: less commercial time. Like, 90 percent less—as little as one minute per hour of viewing, if projections pan out. "The key in the past was volume and frequency," says Clark. "Now it's going to be quality."

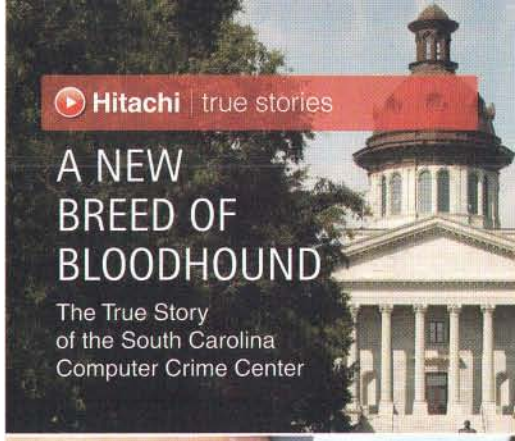
One of the Leiden crew's top priorities is a backend ad engine that can pinpoint viewers by location, time of day, viewing habits, and opt-in profile information to serve up a perfect ad. Developed by open source geeks in privacy-centric Europe, the central database doesn't store any identifying data. Personal information is stored only on the user's own PC. Clark, the ad sales chief, is happy to blue-sky the possibilities: "Buy all the *Desperate Housewives* viewers in a zip code. Or the first thing a given viewer watches on a given day."

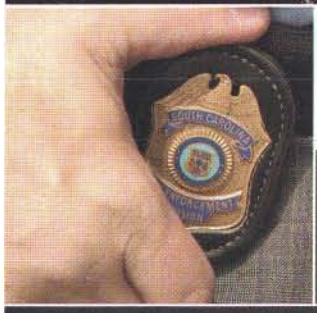
In theory, that kind of control will make the network much more valuable to advertisers. "We offer targeting they've never dreamed about in the TV world," says Werdelin. "And a deeper relationship with customers. Not just deeper than TV, but deeper than most of what you get on the Net. I don't think anyone really knows what those things are worth."

Clark tells a story about a pitch meeting with the head of one of the world's biggest ad and marketing groups. The executive showed up 25 minutes late, sank into a chair, and began inspecting his nails. Then the demo began. He sat bolt upright and asked: "Can we invest?" One reason for that enthusiasm is the ad industry's desperation to stop Google from gaining the same dominance in TV commercials that it has in online ads. And it's no stretch to suggest that marketers will jump at juiced-up television, as long as the viewer numbers justify the hassle of tailoring their marketing efforts to yet another new platform.

Which leaves a final question: content. What's going to be listed on that lovely translucent channel guide when viewers start logging in en masse? The short answer is, at least initially, less than everyone involved would like. What the TV industry calls "A-plus content" is rare by definition. It's also invariably snarled in thickets of exclusive rights. Not to mention that big media companies are rapidly developing their own online plans.

So Zennström and Friis are making a run straight at the most reliable early adopt-





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ers: young men. Watch for sci-fi shows, rock videos, sports, comedy—anything with a testosterone angle. Deals are in the works with the three music majors, plus top US broadcasters and cable channels. For the rest of the world, there's a modified PBS strategy: classic reruns, documentaries, and independent dramas. Nothing too obscure, though: Content that few people want to see—what Leiden engineers call "the too-long tail"—crimps a P2P network's advantage.

At Skype's sleek London headquarters, the two Vikings are penned in a small glass-walled conference room. Zennström is still under the gun to prove the wisdom of eBay's purchase. He has confidence, though, in his recipe for turning bit-powered ideas into money-spinning businesses. "You can't just put a technology out there and hope there will be a business in it," he says. "You have to put together a whole consumer offering, a great instantaneous experience. A simple service that fills an obvious need and can be offered for free."

Friis, whose role in Skype is mainly advisory, plays his part to the hilt, too: director of disruption. "YouTube, Google, Skype—we're transforming whole industries into layers of software and making them more powerful at the same time. Before, it took a huge investment to reach a big audience—transmitters and studios and satellite links. Now you can just be Lonelygirl15."

The mind-bender is that, once upon a time, the Net was supposed to kill television. Now two of the Net's boldest entrepreneurs are trying to reinvent television. And not just broadcast technology but the user interface, the ads, the whole experience. Television perfected!

Five minutes away, at the project's new Covent Garden office, a corner shelf holds an Xbox, a DVD player, and a banged-up TV; over-the-air digital TV, offered by a service called Freeview, is a current UK smash. Even Friis, the perpetual revolutionary, admits a taste for some of the fruits of the *ancien régime*. "What I hate is having all these DVDs piling up with back episodes of *The West Wing*," he says. "TV is so trapped in the box. But the fact is, it's the most powerful medium ever invented. It's not going to just fade away."

Can they wrestle the broadcast beast onto the Net? Friis and Zennström are players now, big names with a fearsome track record. Even more amazing (or scary, if you're a TV insider), they have zero stake in the traditional media pillars. They don't own shows, channels, or networks. They don't have billion-dollar ad deals to protect. Steve Jobs has married Walt Disney. Jeff Bezos is dating Hollywood. Google, the *ur*-online software company, is building a globe-girdling web of proprietary pipes and monster servers. And along come these two Eurogeeks—where the hell is Denmark, anyway?—toting serial killer technology, a multimillion-dollar checkbook, a blank slate, and a crazy dream.

Which, of course, the Venice Project, aka Joost, is. TV and the Net are two of the biggest, most complex media systems ever built. Their ongoing collision—actually a three-way, with phone networks skidding into the nexus—is unleashing forces that overshadow every previous era of media disruption. The Net in particular is brutally centrifugal, fragmenting newspapers into articles, movies into clips, and CDs into songs, all dispersed to servers across the earth. It has never been kind to enterprises that try to gather everything under one roof. Google's $140 billion value derives not from some comprehensive offering but from simply showing people where the fragments can be found. Total solutions like AOL, Netscape, and—yes—Joost swim against the tide.

The bad thing about being Internet rock stars is the temptation to jump into things that most people with a billion dollars would instinctively flee. The good thing is that you might actually succeed. Zennström and Friis have made larger-than-life careers of tackling ever bigger opportunities. Each time, they've dragged a hidebound industry kicking and screaming into the 21st century. Broadcasters, watch your backs.

SPENCER REISS (spencer@upperroad.net) *wrote about Rupert Murdoch and MySpace in issue 14.07*

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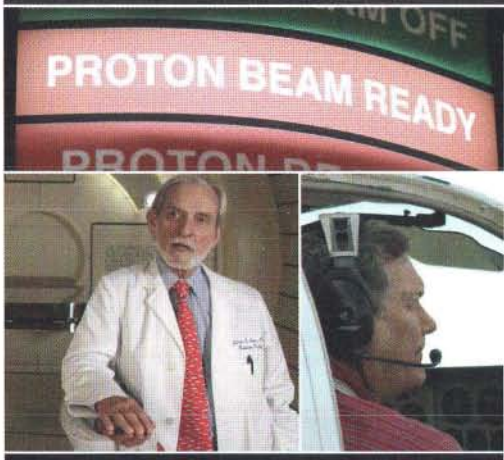
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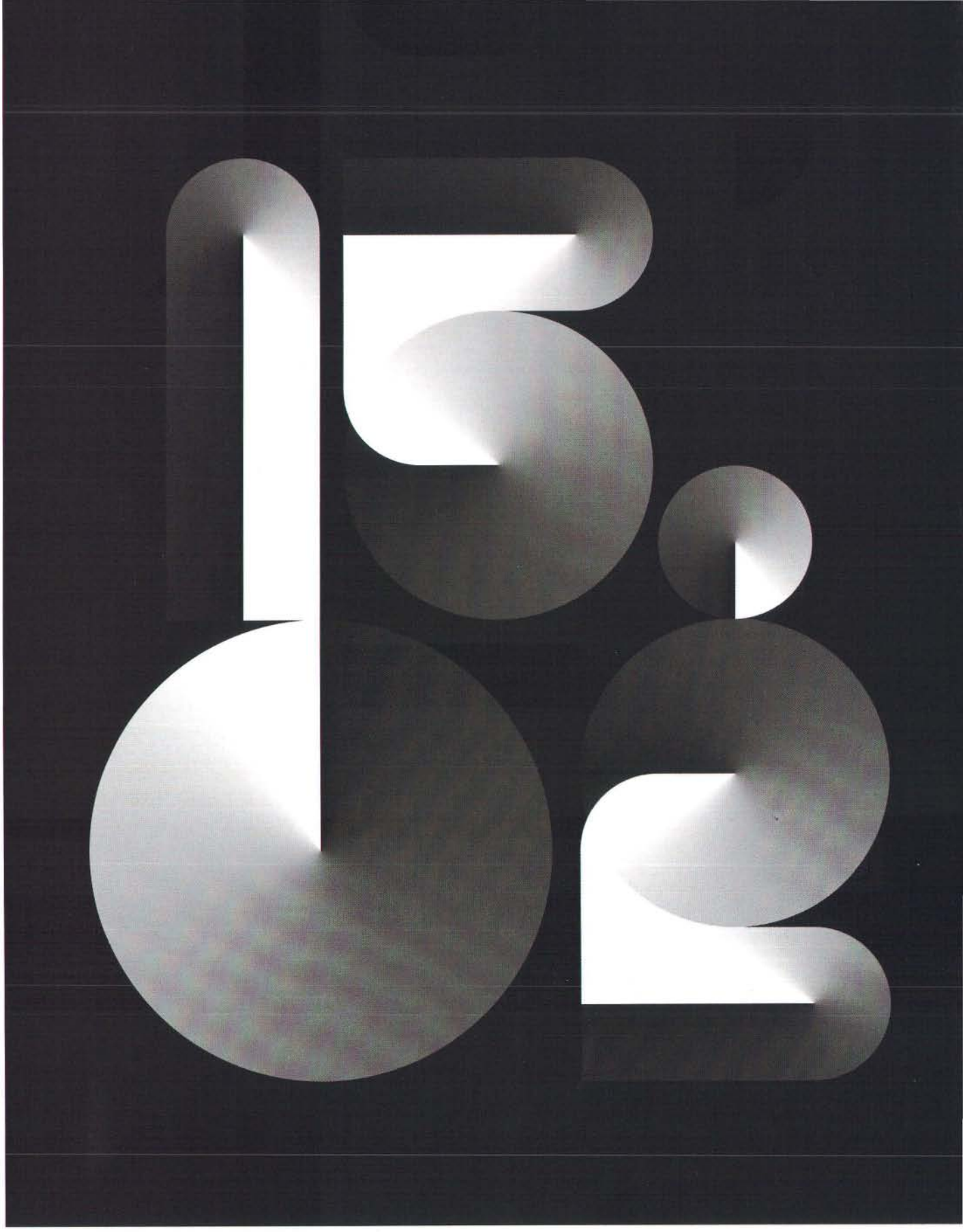
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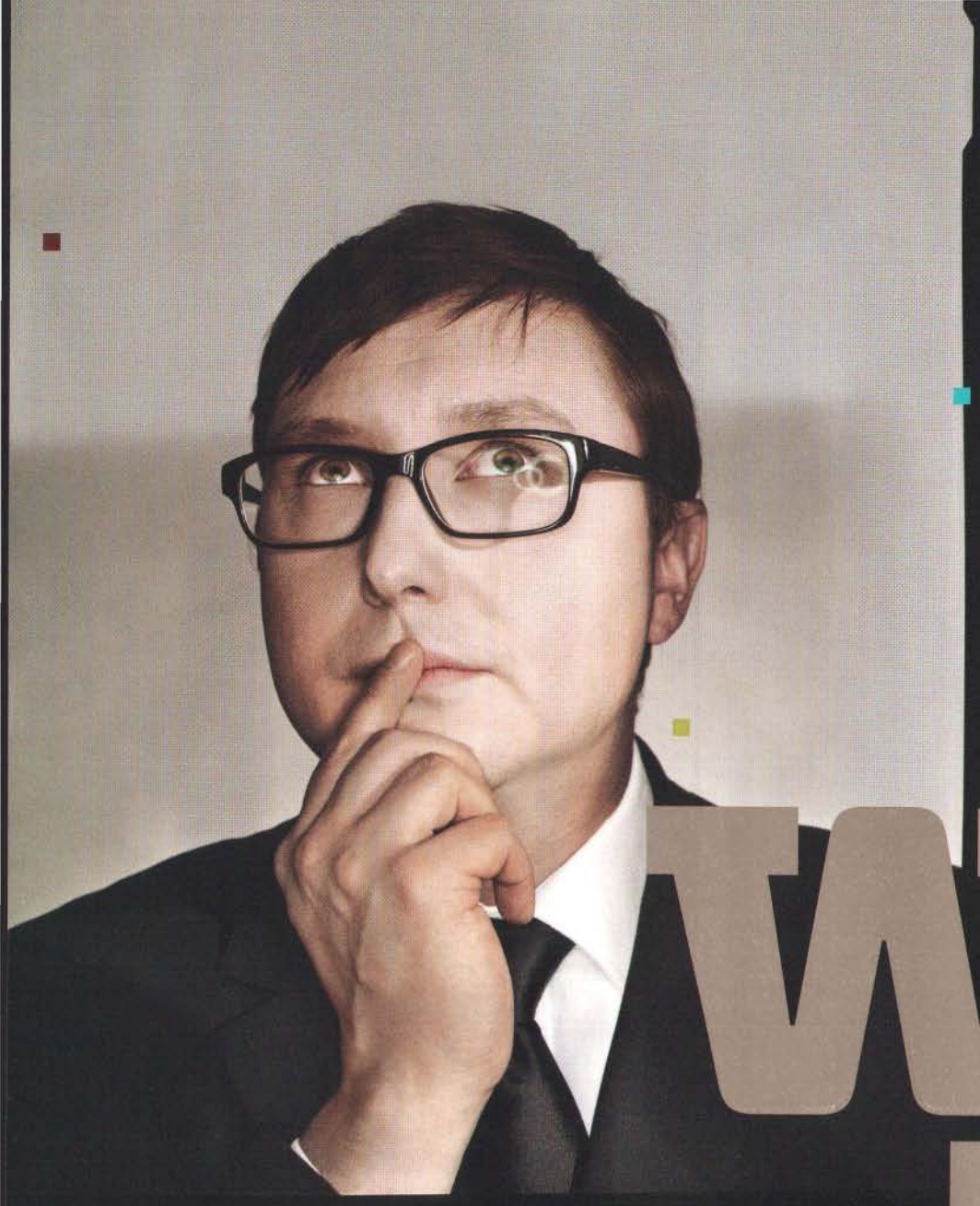
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WHAT WE DON'T KNOW **104** | YAHOO'S MISTAKE **126** | THE GERMS OF WAR **132** | VIRTUAL MTV **140** | WIND FARMS **144**

LETTERING BY **Mario Hugo**



HOW DID LIFE BEGIN? WHAT'S THE UNIVERSE MADE OF? WHY DO WE SLEEP? 42* OF THE BIGGEST QUESTIONS IN SCIENCE.

wh w

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WITH
Natalie Angier
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& more

From the desk of JOHN HODGMAN:

We Don't Know

NOW, I KNOW EXACTLY what you are thinking: *Ha ha. Big Questions? Right. Like I need* WIRED *to tell me what Earth's core is made of. Or what noncoding DNA is for. Oh, and that "Riemann hypothesis"... is that one as* UNSOLVABLE *as the Poincaré Conjecture—the BS Mensa math problem that was just* SOLVED *by a crazy recluse...* IN RUSSIA*? Give me a break, pinheads. (But: nice new fonts.)*

Look, I understand where you're coming from. You are a person of your time: an incurious age when action and certainty (what we in scientific circles call "jockism") seem to outvalue nerdish doubt and curiosity.

I myself am author of a book of COMPLETE WORLD KNOWLEDGE, entitled *The Areas of My Expertise*. As the resident expert on *The Daily Show With Jon Stewart,* there is little left out there in the dark that puzzles me, from nuclear weapons to lice. And while I am not actually a human supercomputer/mentat, I do play one on television, and I understand the temptation to believe that you have all the answers.

But consider William Thomson, the First Baron Kelvin. In 1900, most thinkers agreed that almost every mystery of the physical world had been more or less revealed. The small questions that remained, primarily the properties of light and black-body radiation, were described by Kelvin as twin clouds in the otherwise clear sky of knowledge—perhaps unfathomable, ultimately trivial, and if you looked at them the right way, shaped like fluffy white kittens.

Of course, when acted upon by more curious minds, those clouds would gather into thunderheads. Solving the mysteries of light's behavior led to relativity, and understanding radiation pointed the way to quantum mechanics. Not even Lord Kelvin, sequestered as always in his protective, absolute-zero chamber, would be safe from the resulting tempest of progress and wrenching change.

Now it is 106 years later, and how much more we know still! We would be like gods to the supposed wise men of Lord Kelvin's age, as I learned the hard way during my time travels. I lived among those savage "scientists," with their beastly monocles, and allowed them to fetch me grapes and build statues in my likeness. And I quickly became what most people and societies become when they believe they know everything: incurious, self-satisfied, flabby, and prone to wearing tunics and lounging on grassy

photographs by TOM SCHIERLITZ

lawns while watching those idiot scientists fight with knives for my amusement. Now, I agree that *sounds* awesome, but in reality it was terrible. For one, all the scientists wanted to talk about was those Mac ads. For two, I came to suspect they were planning to eat me. And also, I became less human.

Because in a world where there are no more grails or dragons (thanks a lot, hippies), it is questing after big answers that defines and propels us as a species. Included in this issue are just some of the koanlike brain busters that continue to vex even our most advanced thinkers and magazine writers, mysteries such as ...

How does life arise from nonlife?

What is sleep and why do we do it?

What is the universe made of?

Why is time different from other dimensions?

And that old saw, what is Earth's core made of? (Hint: It's only *partially* nougat, smarty-pants.)

Later, I will give you the rest of the answers in a special BIG ANSWERS issue I am compiling that will be printed upside down and released at the end of the world.

For while there may be legitimate, eternal mysteries out there that are beyond our comprehension, history, in fact, shows us that if we do ask questions, we are likely to find the answers eventually—which is perhaps more frightening than ignorance.

As Lord Kelvin learned the hard way, it's the answers to big questions that will redraw our vision of the world, elevate us in it, or even erase us. And that is why, despite what they tell you, being curious is the bravest human act, aside from skydiving.

But otherwise I agree with you: The new fonts are awesome.

JOHN HODGMAN (hodgman@littlegraybooks.com) *has done all of the things mentioned above.*

What's at Earth's Core?

We know that at the center of the planet, about 4,000 miles down, sits a solid ball of iron the size of the moon. We also know that we're standing on about 1,800 miles of rock, which forms Earth's crust and mantle. But what's in between the mantle and the iron ball? A churning ocean of liquid of some sort, but scientists aren't certain what it's made of or how it reacts to the stuff around it. ¶ We're confident there's a lot of iron in this ocean. But what else? Based on what researchers understand about the pressure, temperature, and density of materials down there, some maintain that the core also contains lots of hydrogen and sulfur. Raymond Jeanloz of UC Berkeley believes that another component is oxygen, which comes from rocks in the part of the mantle that borders the liquid core. ¶ Knowing more about the molten concoction would give scientists clues about how Earth formed and how heat and convection affect plate tectonics. More information could help solve another mystery, too: whether, as many researchers suspect, the inner core is growing. If so, it could eventually overtake the molten metal surrounding it, throwing off Earth's magnetic field.

—GEOFFREY GAGNON, *associate editor at* Boston *magazine*

Is time an illusion?

Plato argued that time is constant—it's life that's the illusion. Galileo shrugged over the philosophy of time and figured out how to plot it on a graph so he could get on with the important physics. Albert Einstein said that time is just another dimension, a fourth one to go along with the up-down, side-side, forward-back we move through every day. Our understanding of time, Einstein said, is based on its relationship to our environment. Weirdly, the faster you travel, the slower time moves. The most radical interpretation of his theory: Past, present, and future are merely figments of our imagination, constructs built by our brains so that everything doesn't seem to happen at once.

Einstein's conception of unified spacetime works better on graph paper than in the real world. Time isn't like those other dimensions—for one thing, we move only one way within it. "What's needed is not to make the notion of time and general relativity work or to go back to the notion of absolute time, but to invent something radically new," says Lee Smolin, a physicist at the Perimeter Institute in Waterloo, Ontario. Somebody is going to get it right eventually. It'll just take time. —ERIN BIBA, *San Francisco-based writer*

Which counts more: nature or nurture? It's the age-old question, oft debated by eccentric millionaires in Philadelphia as they "trade the places" of employees to see whether the ability to rule the pork-belly market is learned or innate. The answer? If one is looking good, one is feeling good, which is to say: nurture.



PRODUCTION: DAWN ZEGADLO, DIGITAL IMAGING: MATT HORN



How does a fertilized egg become a human?

Imagine that you place a 1-inch-wide black cube in an empty field. Suddenly the cube makes copies of itself—two, four, eight, 16. The proliferating cubes begin to form structures—enclosures, arches, walls, tubes. Some of the tubes turn into wires, PVC pipes, structural steel, wooden studs. Sheets of cubes become wallboard and wood paneling, carpet and plate-glass windows. The wires begin connecting themselves into a network of immense complexity. Eventually, a 100-story skyscraper stands in the field.

That's basically the process a fertilized cell undergoes beginning with the moment of conception. How did that cube know how to make a skyscraper? How does a cell know how to make a human (or any other mammal)? Biologists used to think that the cellular proteins somehow carried the instructions. But now proteins look more like pieces of brick and stone—useless without a building plan and a mason. The instructions for how to build an organism must be written in a cell's DNA, but no one has figured out exactly how to read them. —STEVE OLSON, *author of* Mapping Human History

WHAT HAPPENED TO THE NEANDERTHALS?

They were our cousins, our hominid cousins. They looked like us, they walked like us, they may have even thought like us. So why did the Neanderthals disappear, while we *Homo sapiens* dug in and stayed?

Ever since the first Neanderthal bones were discovered 150 years ago in Germany's Neander Valley, paleoanthropologists have sought to understand what could possibly have destroyed the once-thriving and widely dispersed species of prehistoric human. By most measures, the Neanderthals were the equal of our direct ancestors, the fully modern out-of-Africa characters often called Cro-Magnons, with whom the Neanderthals coexisted for thousands of years. Like our forebears, Neanderthals were supple sojourners, happily colonizing parts of Africa, Europe, and Asia. They stood upright, skillfully sculpted and wielded stone tools, and buried their dead with pomp and hope. They were slightly larger and more muscular than their Cro-Magnon counterparts, and their brains were bigger, too. Yet by about 30,000 years ago, the Neanderthals had vanished, leaving Cro-Magnons as the sole survivors of the tangled Hominina tribe. Moreover, while Neanderthals may well have been capable of interbreeding with Cro-Magnons, recent DNA analysis has revealed no signs that such Stone Age Capulet-Montague mergers occurred.

Some scientists have attributed the Neanderthals' demise to chronic disease, pointing out that many Neanderthal skeletal remains show signs of arthritis and other bone disorders. Other people have wondered whether genocide was to blame. Perhaps the Cro-Magnons systematically exterminated their competitors, just as chimpanzees have been observed hunting down and killing every last member of a neighboring chimp troupe.

Another, more recent, hypothesis is that *Homo sapiens* outcompeted *Homo neanderthalensis* because of a difference in their economic systems. Reporting in the December issue of *Current Anthropology*, Steven Kuhn and Mary Stiner of the University of Arizona wrote that the archaeological record suggests all Neanderthals—male, female, adult, child—focused their efforts on "obtaining large terrestrial game." In other words, they were all hunters. The Cro-Magnons, by contrast, appear to have divided labor along more or less sexual lines, with men doing most of the big-game killing, women and children gathering tubers and other plant foods, and everybody sharing the flesh and fruits of their efforts. By adopting this sort of specialization of labor, the researchers speculate, *Homo sapiens* likely proved more efficient and flexible than Neanderthals and were able to expand their population more rapidly.

In other words, at least according to this new theory put forward by Stiner and Kuhn, the Neanderthals weren't felled by a pathogen or a primordial Slobodan Milosevic. They were done in by the bedrock family values of Fred and Wilma Flintstone. —NATALIE ANGIER, *Pulitzer Prize-winning author of* The Canon

Why do we sleep?

It's a catchy phrase: You snooze, you lose. But cutting out those 40 winks would be a bad idea. All mammals sleep, and if they're deprived of shut-eye they die—faster than if they're denied food. But no one really knows why. ¶ Obviously, sleep rests the body. But watching TV does that, too. The answer must lie in the noggin. One leading theory says that while we're awake, a substance builds up in the brain (or gets depleted) and sleep removes (or replenishes) it. That makes sense. For part of the night, the brain idles in an energy-conserving state called slow-wave sleep. Freed from the duties of consciousness, it can focus on cleanup. ¶ The problem with this idea is that another portion of each night, about a quarter, is given to REM sleep, during which the brain is anything but idle. REM stands for rapid eye movement, and it corresponds with vivid dreams, suggesting that it plays a role in consolidating memories. But there's probably more to it: Though antidepressants suppress REM sleep, patients taking them suffer no memory impairment. ¶ In any case, it's clear that pillow time serves a critical purpose. Bad things—like some 100,000 traffic accidents a year, not to mention uncounted instances of calling your spouse by your ex's name—happen when we don't get enough z's. At some point, someone's going to have to dream up a reason. —GRETA LORGE, *assistant research editor at* WIRED

Where did life come from?

Natural selection explains how organisms that already exist evolve in response to changes in their environment. But Darwin's theory is silent on how organisms came into being in the first place, which he considered a deep mystery. What creates life out of the inanimate compounds that make up living things? No one knows. How were the first organisms assembled? Nature hasn't given us the slightest hint.

If anything, the mystery has deepened over time. After all, if life began unaided under primordial conditions in a natural system containing zero knowledge, then it should be possible—it should be *easy*—to create life in a laboratory today. But determined attempts have failed. International fame, a likely Nobel Prize, and $1 million from the Gene Emergence Project await the researcher who makes life on a lab bench. Still, no one has come close.

Experiments have created some basic materials of life. Famously, in 1952 Harold Urey and Stanley Miller mixed the elements thought to exist in Earth's primordial atmosphere, exposed them to electricity to simulate lightning, and found that amino acids self-assembled in the researchers' test tubes. Amino acids are essential to life. But the ones in the 1952 experiment did not *come* to life. Building-block compounds have been shown to result from many natural processes; they even float in huge clouds in space. But no test has given any indication of how they begin to live—or how, in early tentative forms, they could have resisted being frozen or fried by Earth's harsh prehistoric conditions.

Some researchers have backed the hypothesis that an unknown primordial "soup" of naturally occurring chemicals was able to self-organize and become animate through a natural mechanism that no longer exists. Some advance the "RNA first" idea, which holds that RNA formed and lived on its own before DNA—but that doesn't explain where the RNA came from. Others suppose life began around hot deep-sea vents, where very high temperatures and pressures cause a chemical maelstrom. Still others have proposed that some as-yet-unknown natural law causes complexity—and that when this natural law is discovered, the origin of life will become imaginable.

Did God or some other higher being create life? Did it begin on another world, to be transported later to ours? Until such time as a wholly natural origin of life is found, these questions have power. We're improbable, we're here, and we have no idea why. Or how. —GREGG EASTERBROOK, *author of* The Progress Paradox

How much is all the tea in China actually worth?

If you wouldn't do something for all the tea in China, are you cheating yourself? China produces 855,190 metric tons of tea leaf annually. At commodity prices of $1.86 per kilogram, you're missing out on at least $1,590,653,400. Feh. Next time, tell 'em you don't get out of bed for less than all the coffee in Brazil—$6,645,461,089.

Q



How can observation affect the outcome of an experiment?

Paging Captain Obvious: To perform a legitimate experiment, scientists must observe the results of a system in motion without influencing those results. Turns out that's harder than it sounds. In 1927, German physicist Werner Heisenberg discovered that in the Wonderland-like subatomic realm, it is impossible to measure position and momentum simultaneously. "In an attempt to observe an electron or other subatomic particle using light, very short wavelengths of light are required," says David Cassidy, a science historian and Heisenberg expert at Hofstra University. "But when that light hits the electron, it knocks it all over the place like a billiard ball." This can become a serious issue when you're working with the kind of focused, high-intensity beams found in, say, particle accelerators. "The more precise the momentum of the beam particles," Cassidy says, "the more difficult it becomes to focus the beam." ¶ The real problem, though, is what this so-called observer effect does to reality. Do an experiment to find the fundamental unit of light and you find particles called photons. But change the conditions of the experiment and you get waves. Physicists have no problem with the cognitive dissonance of this "wave-particle duality." But ... so ... what's light made out of, really? The dichotomy raises the mind-boggling prospect that unless we observe an event or thing, it hasn't really happened, that all possible futures are quantum probability functions waiting for someone to notice them—trees falling unheard in a forest. Maybe this article wasn't even here until you turned to this page.

—ELIZABETH SVOBODA, *San Jose-based writer*

How do entangled particles communicate?

One of the zanier notions in the plenty zany world of quantum mechanics is that a pair of subatomic particles can sometimes become "entangled." This means the fate of one instantly affects the other, no matter how far apart they are. It's such a bizarre phenomenon that Einstein dissed the idea in the 1930s as "spooky action at a distance," saying it showed that the developing model of the atomic world needed rethinking.

But it turns out that the universe is spooky after all. In 1997, scientists separated a pair of entangled photons by shooting them through fiber-optic cables to two villages 6 miles apart. Tipping one into a particular quantum state forced the other into the opposite state less than five-trillionths of a second later, or nearly 7 million times faster than light could travel between the two. Of course, according to relativity, nothing travels faster than the speed of light—not even information between particles.

Even the best theories to explain how entanglement gets around this problem seem preposterous. One, for example, speculates that signals are shot back through time. Ultimately, the answer is bound to be unnerving: According to a famous doctrine called Bell's Inequality, for entanglement to square with relativity, either we have no free will or reality is an illusion. Some choice.

—LUCAS GRAVES, *New York City-based writer*

Q Where are my keys?

Most brains can handle only five to nine short-term memories at once. Newer information—*phone call! ice cream!*—can bump a previous memory out of storage before it's committed to long-term recall. Even worse, new memories tend to merge with permanent ones, muddying the recollection of ritual activities. Michael "Professor" Solomon, author of *How to Find Lost Objects*, says it's easy to accidentally substitute one routine motion for another. So look for your keys where you normally put your wallet. If that fails, check the car, the sofa cushions, the door lock, and (duh) your pocket. You're probably staring right at them.



WHY DO PLACEBOS WORK?

Tor Wager makes his living inflicting pain. As a psychologist at Columbia University, he zaps people with brief electric surges in order to study the placebo effect, one of the most mysterious phenomena in modern medicine. In one recent experiment, Wager and a group of colleagues delivered harsh shocks to the wrists of 24 test subjects. Then the researchers rubbed an inert cream on the subjects' wrists but told them it contained an analgesic. When the scientists delivered the next set of shocks, eight of the subjects reported experiencing significantly less pain.

The idea that an innocuous lotion could ease the agony of an electric shock seems remarkable. Yet placebos can be as powerful as the best modern medicine. Studies show that between 30 and 40 percent of patients report feeling better after taking dummy pills for conditions ranging from depression to high blood pressure to Parkinson's. Even sham surgery can work marvels. In a recent study, doctors at Houston's Veterans Affairs Medical Center performed arthroscopic knee surgery on one group of patients with arthritis, scraping and rinsing their knee joints. On another group, the doctors made small cuts in the patients' knees to mimic the incisions of a real operation and then bandaged them up. The pain relief reported by the two groups was identical. "As far as I know, the placebo effect has never raised the dead," says Howard Brody, a professor at the University of Texas Medical Branch and author of a book on the subject. "But the vast majority of medical conditions respond to placebo at least to some degree."

How do placebos have such an effect? Nobody knows. Studies have shown that our brains can release chemicals that mimic the activity of morphine when we're treated with placebo analgesics. But only lately have researchers begun to pin down the underlying physiological mechanisms. In his groundbreaking electrical-shock experiment, Wager used functional MRI to examine images of the brain activity of his subjects. When a person knew a painful stimulus was imminent, the brain lit up in the prefrontal cortex, the region used for high-level thinking. When the researchers applied the placebo cream, the prefrontal cortex lit up even brighter, suggesting the subject might be anticipating relief. Then, when the shock came, patients showed decreased activity in areas of the brain where many pain-sensitive neurons lead.

One day, this sort of research could point toward new treatments that harness the mind to help the body. Until then, doctors are divided on the ethics of knowingly prescribing placebos. Some think it's shady to perform mock surgery or offer a patient pills that contain no active ingredients. Yet the best doctors have always employed one form of placebo: Studies show that empathy from an authoritative yet caring physician can be deeply therapeutic. Maybe handing out the occasional sugar pill isn't such a bad idea.

—SHANNON BROWNLEE, *senior fellow at the New America Foundation*

What is the Large Hadron Collider?

The Large Hardon Collider is a giant particle accelerator: a 17-mile-long tunnel beneath Switzerland and France. With it, scientists hope to isolate the Higgs boson, the particle that could explain mass. Some worry that the Hardon Collider is *too* big and could create a black hole that, while awesome, would destroy Earth. Is such a huge Hardon Collider worth it? Why are you laughing? Oh. Oh. I see. My mistake. I meant to say "Large Erection Collider."





WHAT IS THE UNIVERSE MADE OF?

Astronomers scouring the heavens with powerful telescopes can see objects that are billions of trillions of miles away. These observations have proven essential to piecing together a fairly refined picture of the history and evolution of the cosmos. Nevertheless, a gaping hole remains in our understanding of a basic question: What is the universe made of? For more than 100 years we've known about atoms, and over the past century or so we've gone further and identified atomic constituents like electrons and quarks, as well as their exotic cousins—neutrinos, muons, and the like. But there is now convincing evidence that these ingredients are a cosmic afterthought. Current data shows that if you weighed everything in existence, these familiar particles would amount to about 5 percent of the total. Most of the universe is composed of other stuff, which, with all of science's deep insights, we've yet to identify.

How do we know this? Well, over the course of many decades, astronomers studied the motion of galaxies and the stars within them, and found that the gravity exerted by this luminous matter was insufficient to account for the way these heavenly bodies moved. Only by positing large amounts of additional matter that doesn't give off light (visible, x-ray, infrared, or any other kind) and is thus invisible to telescopes, could the data be explained. Through detailed cosmological measurements, scientists also discovered that this so-called dark matter couldn't be made of the same electrons, protons, and neutrons that make up everything with which we are familiar.

Then, in the late 1990s, two groups of astronomers, one led by Saul Perlmutter of the Lawrence Berkeley National Laboratory, the other by Brian Schmidt of the Australian National University, found something even stranger. Through observation of distant supernovas, these astronomers measured how the expansion rate of the universe has changed over time. Because of gravity's relentless pull, most everyone expected that the expansion would be slowing. But the data from both groups showed the opposite. The expansion of the universe is speeding up. Something must be pushing outward, and luckily Einstein's general theory of relativity provides a ready-made candidate: A uniform, diffuse energy spread throughout space can act as an antigravity force. Since this energy gives off no light, it's called dark energy.

Collectively, the observations establish that about 23 percent of the universe is dark matter and about 72 percent is dark energy. Everything else is squeezed into the remaining few percent.

Several experiments are now under way to identify dark matter. Scientists are searching for what they suspect is an exotic species of particle. Some studies are looking for clues by analyzing particles bombarding Earth from space; others, like the Large Hadron Collider, will analyze collisions between extremely fast-moving protons that have the potential to create dark matter in the lab. We are guardedly optimistic that we'll be able to identify dark matter soon.

By contrast, the question of dark energy is wide open. What is its origin? What determined its quantity? Does the amount stay constant or vary? These are critical questions. Calculations show that if the amount of dark energy had been slightly larger, the universe would have blown apart so quickly that life as we know it could not exist. —BRIAN GREENE, *author of* The Elegant Universe

Why do hot dogs come in packs of 10 while buns come in packs of 8 or 12?

Bakers tend to package their wares in dozens or in other multiples of three or four. Meatpackers sell by the pound, and a standard hot dog is 0.1 pounds. Oscar Mayer insists that only 10 consumers—or is it 12?—write in annually to complain.



What is the purpose of noncoding DNA?

A typical human cell contains more than 6 feet of tightly cornrowed DNA. But only about an inch of that carries the codes needed to make proteins, the day laborers of biology. What's the other 71 inches? ¶ It's junk, Nobelist Sydney Brenner said after it was discovered back in the 1970s. The name stuck, but biologists have known for a while that the junk DNA must contain treasures. If noncoding DNA were just along for the ride, it would rapidly incorporate mutations. But long stretches of noncoding DNA have remained basically the same for many millions of years—they must be doing something. ¶ Now scientists are starting to speculate that proteins, and the regular DNA that creates them, are just the nuts and bolts of the system. "They're like the parts for a 757 jet sitting on the floor of a factory," says University of Queensland geneticist John Mattick. The noncoding DNA is likely "the assembly plans and control systems." Unfortunately, he concludes, because we've spent 30 years thinking of it as junk, we're just now learning how to read it. —STEVE OLSON

Is time travel possible? As noted in my introduction (page 104), the answer is yes. The important part is knowing what to take with you. Backward: a stick for fending off cavemen and scientists, newspapers from the present to blow people's minds, photographs of your parents so you can recognize them and not accidentally kill them, ROCK AND ROLL! Forward: anti-Morlock spray, feathered hair, and a unitard (cream-colored with gold trim is expensive but indicates high caste and makes it less likely that you will be eaten).





WILL FORESTS SLOW GLOBAL WARMING— OR SPEED IT UP?

Everyone knows that forests are good for the environment. By removing carbon dioxide—the principal cause of global warming—from the air, trees grow. And the bigger and more plentiful the trees, the more CO_2 they sequester. This makes forests a helpful bulwark against climate change. But despite the best carbon-eating action of our flora, the planet is heating up. This raises the specter of a future in which, paradoxically, forests don't reduce climate change but—as they are destroyed—make it worse.

We don't know which way it will go, because we know so little about forests themselves. Scientists estimate that up to 50 percent of all species live in forest canopies—three-dimensional labyrinths largely invisible from the ground—but virtually no one can tell you what lives in any given cubic meter of canopy, at any height, anywhere in the world. We don't even have names for the most common species of trees in the Amazon.

But scientists can readily foresee the way in which these carbon killers instead become dangerous carbon spewers. As the climate warms, many forests will become drier, putting the trees under stress. Typically, this sets the stage for huge outbreaks of insects, which can strip trees of their leaves, killing large numbers of them. Once dead, trees release their carbon into the air—already roughly 25 percent of the greenhouse gases pouring into the atmosphere come from forests that are burned or cut down. Further, if they no longer exist, forests can't absorb CO_2 anymore, and the bare ground that is exposed heats up faster—forests are like giant swamp coolers for the planet.

Will this happen? Hard to say. If we don't know which insects are eating the leaves now, we can't gauge how global warming will affect them or how they in turn might affect forests. "You can't possibly answer more general questions about forests until you at least know what lives there," says Margaret Lowman, canopy scientist at New College of Florida. "It's more than just giving names to things. We need to know what's common and what's rare, and what these species are doing, before we can go to the next level, which is to try to see the interaction between forests and Earth's climate." —RICHARD PRESTON, *author of the upcoming* The Wild Trees

What happens to information in a black hole?

Inside a black hole, gravity is so intense that neither matter nor energy can escape. But in 1975, Cambridge physicist Stephen Hawking said that something does escape: random particles now known as "Hawking radiation." So if black holes eat organized matter—chock-full of information—and then spit out random noise, where does the information go? ¶ Hawking said it gets locked up inside as the black hole eventually evaporates, destroying the information in the process. Which creates a paradox. Because the rules of physics say information, like matter and energy, can't be destroyed. ¶ Hawking was confident. He convinced his supergenius counterpart at Caltech, physicist Kip Thorne, that he was right—but Thorne's colleague John Preskill remained skeptical. So they made a bet: Hawking and Thorne said the singularity at the heart of a black hole destroyed information; Preskill said "nuh-uh." Then, in 2004, Hawking reversed his position and decided that things that fall into a singularity aren't lost; their information does leak out, though no one, except maybe Hawking himself, can explain why or how. ¶ He presented Preskill with a baseball encyclopedia from which, presumably, information can be retrieved at will. Preskill accepted only grudgingly. "Even if you're Stephen Hawking, it's possible to be wrong twice," he says. —ERIN BIBA

What causes ice ages?

Scientists know that small-scale ice ages occur every 20,000 to 40,000 years and that massive ones happen every 100,000 years or so. They just don't know why. The current working theory—first proposed in 1920 by Serbian engineer Milutin Milankovitch—is that irregularities in Earth's orbit change how much solar energy it absorbs, resulting in sudden (well, geologically speaking) cooling. While this neatly fits the timing of short-term events, there's still a big problem. Over the past few decades, studies have shown that orbital fluctuations affect solar energy by 1 percent or less—far too little to produce massive climate shifts on their own. "The mystery is, what is the amplification factor?" says University of Michigan geologist and climatologist Henry Pollack. "What takes a small amount of solar energy change and produces a large amount of glaciation?" ¶ Studies of ice and seabed cores reveal that temperature rise and fall is heavily correlated with changes in greenhouse-gas concentrations. But it's a chicken-and-egg problem. Are CO_2 rises and falls a cause of climate change or an effect? If they are a cause, what initiates the change? Figuring this out could tell us a great deal about the current global warming problem and how it might be solved. But as Matthew Saltzman, a geologist at Ohio State puts it, "We need to know why greenhouse gases fluctuated in prehuman times, and we just don't." —JOHN HOCKENBERRY

How does the brain calculate movement?

All of science, it seems, wants to know how brains give animals complex motor skills. Robotics, physics, neurophysiology, and medicine are just a few of the disciplines studying the topic. The paradox is that brains—even large human brains—are notoriously slow by processing standards: Set your hand on a hot plate and it takes full milliseconds to feel the burn. So how does the same gooey substance simultaneously acquire visual data, calculate positional information, and gauge trajectory to let a lizard's tongue snatch a fly, a dog's mouth catch a Frisbee, or a hand catch a falling glass? "With the thousands of muscles in the body, the motor cortex clearly isn't 'thinking' in any sense about movement," says UC San Diego neuroscientist Patricia Churchland. According to Stanford University's Krishna Shenoy, the brain seems to create an internal model of the physical world, then, like some super-sophisticated neural joystick, traces intended movements onto this model. "But it's all in a code that science has yet to crack," he says. Whatever that code is, it's not about size. "Even a cat's brain can modify the most complicated motions while executing them." —JOHN HOCKENBERRY, WIRED *contributing editor*

Why do the poles reverse?

Almost 800,000 years ago, compasses would have pointed south. A little further back, they would have pointed north. Evidence for such reversals comes from lava flows and cracks in the ocean floor, places where newly formed rock makes a record of the magnetic polarity. ¶ We know that as Earth spins, the liquid metal in its molten core churns, generating an electromagnetic field. We also know that shifts in the movement of the core can alter the polarity of that field and that it takes about 7,000 years for the orientation to flip-flop once the process of reversal begins—something that happens on average two or three times every million years. But no one knows how it works. Some scientists believe the poles migrate slowly from one end to the other; some theorize that the magnetic field shuts down and then reemerges with opposite polarity. ¶ As for what triggers the event, experts have suggested that a huge impact—say, a giant meteor—could create a disturbance in the core. But research by Gary Glatzmaier, a planetary science professor at UC Santa Cruz, shows that a violent catalyst isn't needed. So why does pole reversal occur? "That's like asking, why do hurricanes start?" he says. "Well, they're always trying to, and sometimes the conditions are just right." —GEOFFREY GAGNON

HOW DOES THE BRAIN PRODUCE CONSCIOUSNESS?

That slab of meat in your skull—a 3-pound walnut of wetware—somehow puts the *you* in you. Nobody really knows how. Philosophers since Plato have pondered the issue. And probing the relationship between mind and body was the central goal of psychology until behaviorists closed the door on mind in the early 20th century and focused on observable actions. But only recently have scientists tried to tackle consciousness, spurred by new tools like functional MRI and PET scans that can augment traditional clinical research by showing brain activity.

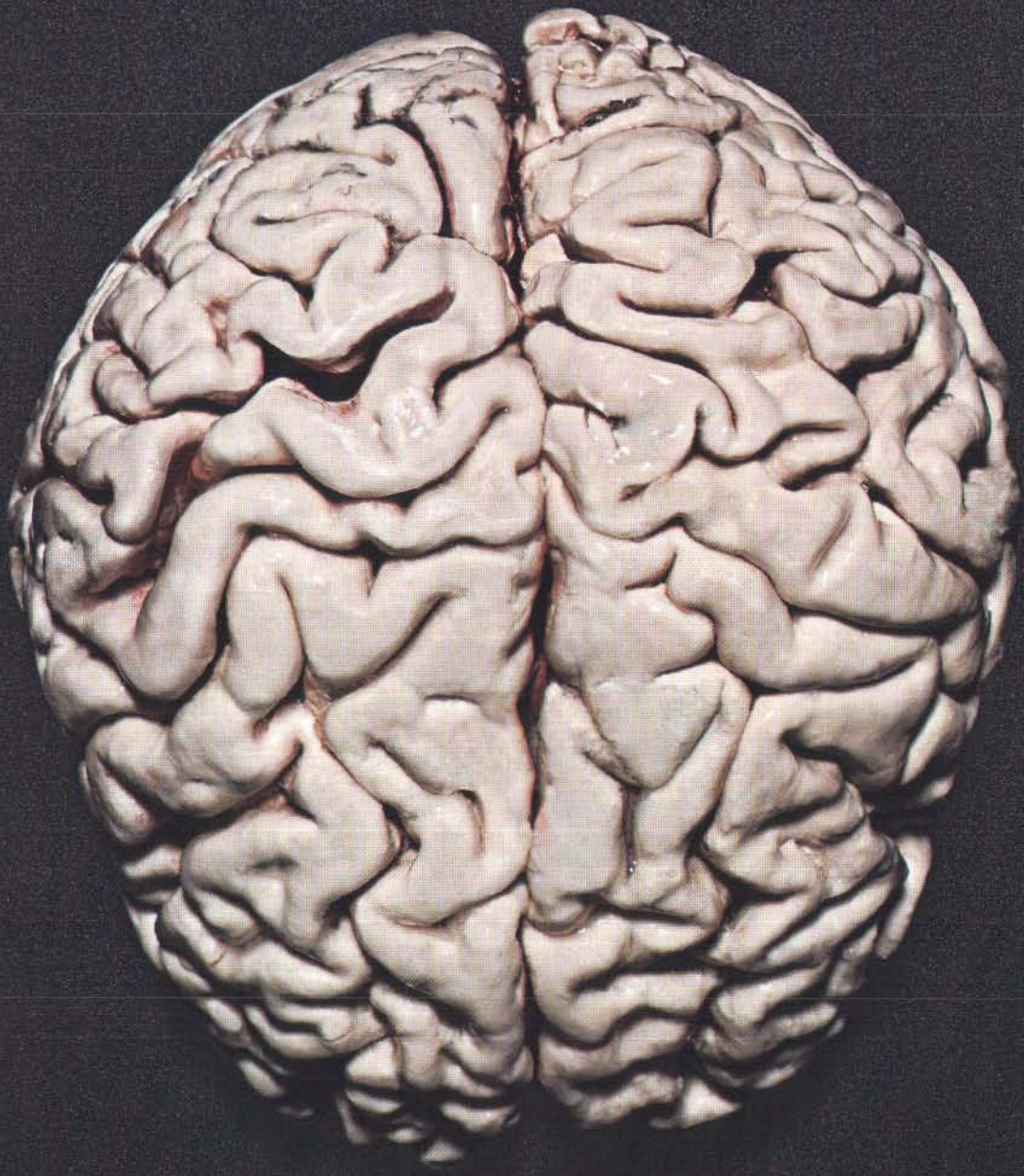
Already, however, these researchers find themselves haggling over familiar questions. Is consciousness merely wakefulness? No, we're conscious when we dream. Is it our sense of personal identity? Yes, but surely it's also the stream of words and images that runs through what William James called the "extended present," the immediate workspace of our minds. It's perception, but it's also reflection—summoning up visual and verbal constructions, imaginary or real. It's simulation, mentally walking ourselves through situations before we face them, learning and practicing, hoping to avert pratfalls.

No surprise, then, given this confusion, that scientific theories on consciousness are all over the map. Antonio Damasio, a neurologist and neuroscientist at the University of Southern California who studies brain-damaged patients, speculates that self-awareness evolved in humans as a regulatory mechanism, a way for the brain to understand what is going on with the body. He calls "the coming of the sense of self into the world of the mental" a "turning point in the long history of life." Caltech's Christof Koch, who studies vision as the starting point for mind, believes that people have specific "consciousness neurons." And Bernard Baars of the Neurosciences Institute in San Diego suggests that consciousness is a controlling gateway to unconscious mechanisms such as working memory, word meanings, visual memory, and learning.

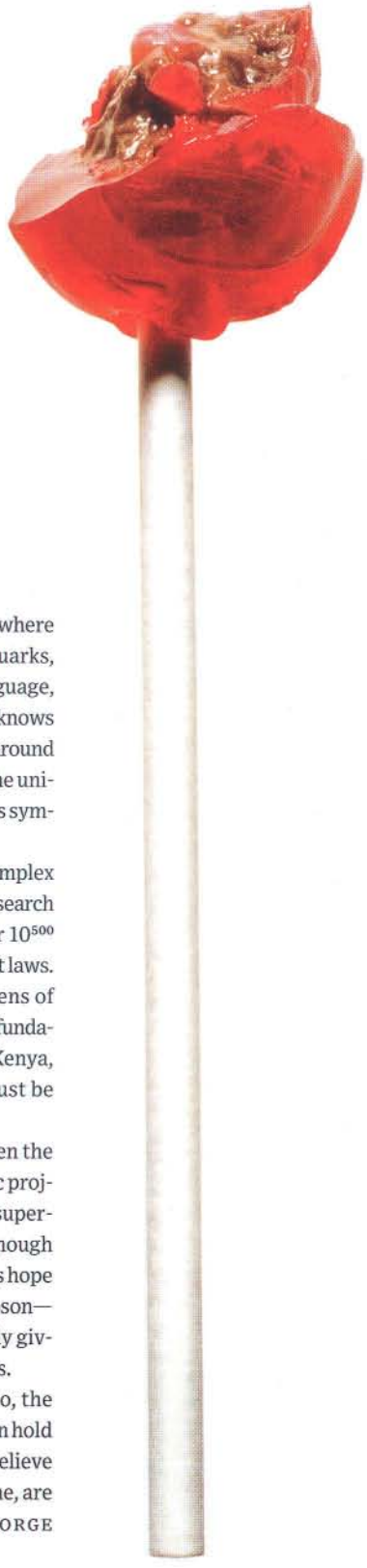
Some philosophers still argue that consciousness is too subjective to explain, or that it is the irreducible result of matter organized in a specific way. That philosophic black-boxing is probably more nostalgic than scientific, a clinging to the idea of a spirit or soul. Without that, after all, we're just organisms—more complex, but no less predictable, than dung beetles. But scientists live to reduce the seemingly irreducible, and sentimentality is off-limits in the lab. Understanding consciousness means finding the biophysical mechanisms that generate it. Somewhere behind your eyes, that meat becomes the mind. —RICHARD RHODES, *Pulitzer Prize-winning author of* The Making of the Atomic Bomb

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What is belly button lint? A survey by Karl Kruszelnicki of the University of Sydney suggests that a mixture of clothing fibers and dead skin is "surfed" into the typical belly button by midweight happy trails. Mena Suvari and Britney Spears are spared this indignity, as were our Cro-Magnon ancestors. Why? Mena's outie doesn't collect it, Brit's piercing blocks it, and Ogg's thick body hair stopped fuzz migration.



How many licks does it take to get to the center of a Tootsie Roll Pop? Licking machines built by engineering students at Purdue and the University of Michigan hit the chewy center in an average of 364 and 411 licks, respectively. But robot tongues aren't the most efficient. Tests involving actual people have determined that it really takes 252 swipes at most.



WHY IS FUNDAMENTAL PHYSICS SO MESSY?

When the job description calls for reverse-engineering the universe, the pool of successful applicants will naturally include enough self-impressed overachievers to make second-degree ego burn a hazard of the trade. But even the leading researchers in theoretical particle physics, the most headstrong of the scientific elite, are humbled by their failure to figure out why the cosmos is such a mathematically elegant mess.

The equations themselves are lovely, describing how a baseball arcs parabolically between earth and sky or how an electron jumps around a nucleus or how a magnet pulls a pin. The ugliness is in the details. Why does the top quark weigh roughly 40 times as much as the bottom quark and, even worse, thousands of times more than the up quark and down quark combined? Maddeningly, the proton weighs almost, but not exactly, the same as its counterpart, the neutron. And wasn't the electron enough? Did we really need its two fat cousins, the muon and the tau?

It's as though some software engineer crafted a beautiful, bugless operating system—the laws of physics—and then fed it with random data, the output from a lava lamp, or moths bashing at a window screen. Garbage in, garbage out, generating the weird, starry heap of a universe we call home.

Optimists hope the randomness is actually pseudo-random—complexity in disguise, with The Algorithm at the core of everything, churning out the details, demanding that things be what they be.

The bet is that this codex lies tangled somewhere inside superstring theory. Deep within the quarks, face-to-face with the universal machine language, are tiny snippets of something—no one really knows what—called strings and branes. They wiggle around in their 10 or so dimensions and conjure up the universe, this universe, with a spec sheet about as symmetrical as a bingo card.

Superstring theory turns out to be more complex than the universe it is supposed to simplify. Research suggests there may be 10^{500} universes ... or 10^{500} regions of this universe, each ruled by different laws. The truths that Newton, Einstein, and dozens of lesser lights have uncovered would be no more fundamental than the municipal code of Nairobi, Kenya, or Terre Haute, Indiana. Physicists would just be geographers of some accidental terrain.

Things might look brighter next year, when the Large Hadron Collider—the biggest scientific project ever—should be running full blast, using superconducting magnets to smash matter hard enough to break through the floor of reality. Physicists hope that down in the cellar they'll find the Higgs boson—skulking in the dark like a centipede, furtively giving the other particles their variety of masses.

Or maybe they'll just find more junk. If so, the search will probably be over for now, placed on hold for the next civilization with the temerity to believe that people, pawns in the ultimate chess game, are smart enough to figure out the rules. —GEORGE JOHNSON, *author of* Miss Leavitt's Stars



If there is life on other planets, why haven't they contacted us? You paraphrase Fermi's Paradox, first posed by the physicist Enrico Fermi in 1950 over lunch with some colleagues. During the same lunch, he also disproved the existence of UFOs, Sasquatch, fairies, God, and love. After that, he generally ate alone. But Fermi's apparent logic overlooked two important probabilities: (1) the aliens are very far away and don't believe we exist, and (2) Enrico Fermi was himself probably a space alien. I mean: Look at him.

How doth human language evolve?

Lots of animals make noise; much of it even conveys information. But for sheer complexity, for developed syntax and grammar, and for the ability to articulate abstract concepts, you can't beat human speech. MIT linguist Noam Chomsky and Harvard experimental psychologist Steven Pinker say it's genetic. Pinker theorizes that language emerged about 200,000 years ago, when early humans who were efficient communicators were more likely to pass on their genes. (Less-than-efficient communicators were more likely to scream incoherently—instead of imparting an escape plan—before being devoured by a saber-toothed tiger.) A little more evidence: People with particular genetic defects have specific difficulties with speech and grammar. ¶ Other scientists argue that spoken words are actually an outgrowth of other human skills, such as planning, memory, and logic. "There is no 'language gene,'" says Luc Steels, a computer scientist at the Free University of Brussels in Belgium. "Language was a cultural breakthrough, like writing." Steels built robots with a set of general intelligence traits but without a language module in their software, and they developed grammar and syntax systems similar to those of human language. ¶ Blame neuroscientists for the controversy. The parts of the brain thought to be responsible for language are as well-understood as the rest of the brain, which is to say: not so much. —ELIZABETH SVOBODA

Why can't we predict the weather?

A few years ago, weather forecasts were totally unreliable beyond a couple of days; today better computer models make them accurate as far as a week out. That's fine for figuring out how to pack for a business trip or whether you need to rent a big tent for the wedding reception. The trouble starts when you want to build a computer model to predict the weather over decades or centuries. In 1961, a meteorologist named Edward Lorenz was running a computerized weather simulation and decided to round a few decimal places off one of the parameters. The tiny tweak completely changed weather patterns. This became known as the butterfly effect: A butterfly flapping its wings in Brazil sets off a tornado in Texas. Lorenz's shortcut helped launch chaos theory and sparked an obsession among meteorologists with feeding as-perfect-as-possible data into their models in an attempt to lengthen their forecast window. ¶ But even refining precision doesn't get us to long-term prediction. For that, climatologists need to understand boundary conditions, like the interactions between the atmosphere and the oceans. The goal, says Louis Uccellini, director of the National Centers for Environmental Prediction, is to model Earth as a single climate system. Then we can figure out what'll happen to it next. —LUCAS GRAVES, *New York City-based writer*



Why don't we understand turbulence?

An airplane's sudden loss of lift, liquid fuel igniting inside a rocket engine, blood clotting in an artificial heart valve—turbulence can be deadly. When a liquid or gas moves smoothly, it's easy to go with the flow. But change certain conditions—speed, viscosity, surrounding space—and the orderly current dissolves into whirling chaos. If we could model the physics of turbulent flow in software, we could use the model's output to design safer, more-energy-efficient machines. ¶ The trouble is complexity. When a stream of water or air goes turbulent, groups of molecules form vortices of widely varying sizes that interact in seemingly random ways. To determine the outcome, we'd have to measure the initial conditions to an impractical degree of precision. And in any case, tracking a zillion particles is beyond the reach of any conceivable computer. ¶ If we can't predict how a given turbulent system will behave, at least we can simplify it enough to zero in on statistical likelihoods. The key is the transition zone: the precise spot where smooth flow breaks down. Here, chaos theory describes the proliferation of whorls, while the science of cellular automata, which imposes a grid over reality, reduces complex interactions to a limited number of simple equations. These mathematical tricks don't bring turbulence to heel, but they do get engineers close enough to make reasonably sure your plane touches down on time ... and in one piece. —WIL McCARTHY, *author of* To Crush the Moon

Why do fools fall in love?

Blame the neurochemicals that fuel the brain's built-in reward system. Triggered by the sight (or smell) of that special someone, the brain releases dopamine, upping the desire for sex. Serotonin levels plummet, creating that "can't live without you" feeling. The attachment chemicals, oxytocin and vasopressin, also kick in. No fool can resist.

Q

Is the universe actually made of information?

Humans have talked about atoms since the time of the ancients, and ever-smaller fundamental particles of matter followed. But no one even conceived of *bits* until the middle of the 20th century. The bit is a fundamental particle, too, but of different stuff altogether: information. It is not just tiny, it is abstract—a flip-flop, a yes-or-no. Now that scientists are finally starting to understand information, they wonder whether it's more fundamental than matter itself. Perhaps the bit is the irreducible kernel of existence; if so, we have entered the information age in more ways than one.

The quantum pioneer John Archibald Wheeler, perhaps the last surviving collaborator of both Albert Einstein and Niels Bohr, poses this conundrum in oracular monosyllables: "It from bit." For Wheeler, it is both an unanswered question and a working hypothesis, the idea that information gives rise, as he writes, to "every it—every particle, every field of force, even the spacetime continuum itself." This is another way of fathoming the role of the observer, the quantum discovery that the outcome of an experiment is affected, or even determined, when it is observed. "What we call reality," Wheeler writes coyly, "arises in the last analysis from the posing of yes-no questions." He adds, "All things physical are information-theoretic in origin, and this is a participatory universe."

Earlier generations would not have been able to imagine information as so ... meaty. How could this abstract quality be substantial enough—enough of a *thing*—to be the substrate of all existence? Its newly powerful status began to emerge in 1948, when Claude Shannon at Bell Labs invented information theory. His scientific framework introduced the bit, defined concepts like signal and noise, and pointed the way to modems and compact discs, cell phones and cyberspace, Moore's law, Metcalfe's law, and a world of silicon valleys and alleys.

Now the whole universe is seen as a computer—a cosmic processor of information. When photons and electrons and other particles interact, what are they really doing? Exchanging bits, transmitting quantum states. Every burning star, every silent nebula, every particle leaving its ghostly trace in a cloud chamber is an information processor. The universe computes its own destiny.

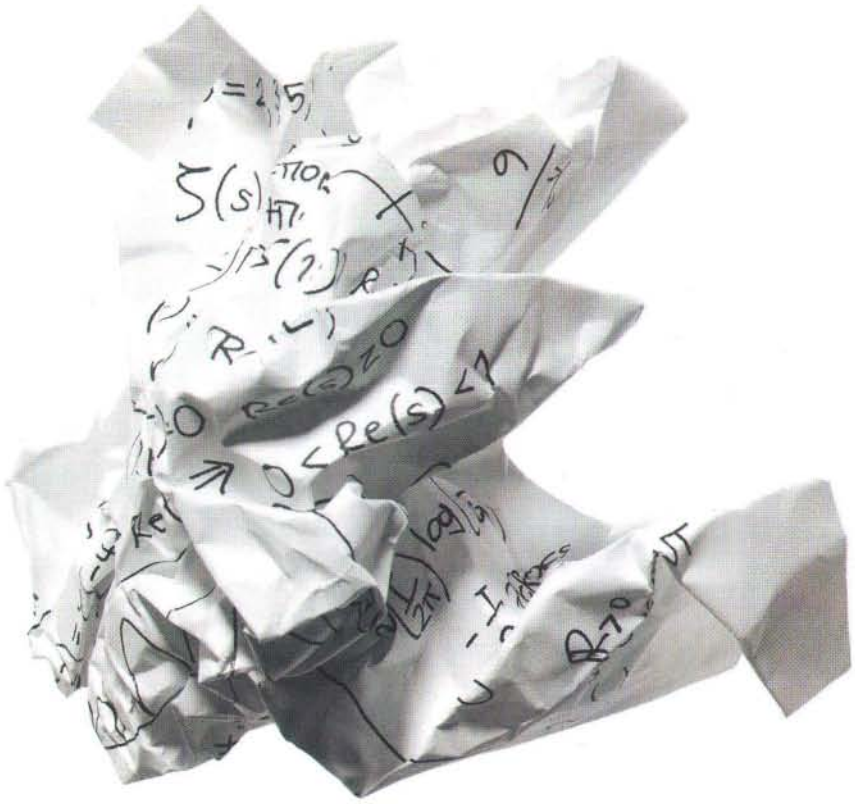
How much does it compute? How fast? How big is its total information capacity, its memory space? What is the link between energy and information—the energy cost of flipping a bit?

These are hard questions, but they are not mystical or metaphorical. Physicists and quantum-information theorists are using the bit to look anew at the mysteries of thermodynamic entropy and at those notorious information swallowers, black holes. They're doing the math and producing tentative answers. To the small questions, that is.

For Wheeler, the big question of which comes first, the material universe or information, is a way of posing an even bigger question: "How come existence?" How does something arise from nothing? And that, it's safe to say, is a question science cannot answer. —JAMES GLEICK, *author of* Isaac Newton

Why do some diseases turn into pandemics?

A pandemic—a transnational outbreak of disease—is really just a pathogen on a hot streak. After all, germs want what we all want, evolution-wise: to spread their genes. Success in the germ world means infecting a whole lot of people, reproducing, then infecting a whole lot more. The efficiency with which a microbe pulls that off depends on how the bug works and how the target—us—works. HIV, for example, loves a promiscuous-but-prudish population; human beings like to have sex but don't like to talk about condoms. The Ebola virus, on the other hand, hasn't found victims who exchange fluids with enough other people before dying (horribly). So changes in culture like jet airplane travel can make a population more vulnerable to a previously contained disease. And changes in a germ—say, if avian influenza H5N1 acquires the right genes from the human version—can be like spinach to Popeye. But no one knows how to predict when either of those things might happen. So don't forget to wash your hands. A lot. —ELIZABETH SVOBODA



Can mathematicians prove the Riemann hypothesis?

In the early 1900s, German mathematician David Hilbert said that if he awakened after 1,000 years of sleep, the first question he'd ask would be: Has the Riemann hypothesis been proven?

It's been only 100 years, but the answer so far is no. Put forward by Bernhard Riemann in 1859, the hypothesis would establish the distribution of zeroes on something called the Riemann zeta function. That, in turn, correlates to the intervals between prime numbers.

Prime numbers (numbers that can be divided only by 1 and themselves: 2, 3, 5, et cetera) are the building blocks of mathematics, because all other numbers can be arrived at by multiplying them together (e.g., 150 = 2 x 3 x 5 x 5). Understanding the primes sheds light on the entire landscape of numbers, and the greatest mystery concerning primes is their distribution. Sometimes primes are neighbors (342,047 and 342,049). Other times a prime is followed by desert of nonprimes before the next one pops up (396,733 and 396,833).

Making sense of this bizarre arrangement would offer a base from which to solve numerous other long-standing math problems and could affect related fields, like quantum physics. Until they know whether it's true, though, mathematicians can't use Riemann. Princeton mathematician Peter Sarnak put it this way: "Right now, when we tackle problems without knowing the truth of the Riemann hypothesis, it's as if we have a screwdriver. But when we have it, it'll be more like a bulldozer." Which is why the Riemann hypothesis has been named one of the Clay Millennium prize problems: Whoever proves (or disproves) it gets $1 million. —SIMON SINGH, *author of* Fermat's Enigma



Do nonhuman animals have culture? Yes. Anyone who has read *Watership Down* knows that animals have religion, art, literature, and Owsla—the four pillars of culture as defined by most experts. But it's not just rabbits who are writing novels. Did you know that *Absalom, Absalom!* was written by snakes?

WHY DO WE DIE WHEN WE DO?

When asked why things die, physicists don't hesitate: It's the second law of thermodynamics. Everything, be it mineral, plant, or animal, a Lexus or a mitral valve or a protein in a cell wall, eventually breaks down. What that looks like in humans—what exactly it is that makes us age—is a question for biologists. It's DNA damage by free radicals, maybe, or shrinkage of the caps on chromosomes. Telomeres, as they're called, get smaller with each cell division. When they hit a certain length: apoptosis, or cell death.

But for the best explanation of the when of our mortality, you have to ask the ecologists. They have a rough way of calculating life span. Basically, the larger the species, the slower its energy-delivery systems (all that internal tubing, all that complicated traffic); the lower the metabolic rate, the longer the life. Animals can live fast or burn slow. "If you've ever picked up a little mouse, it's effectively vibrating, its heart is beating so fast," says Brian Enquist, an ecologist at the University of Arizona. "A blue whale's heart is like a slow metronome or the ringing of a church bell, a very slow bong ... bong ... bong." Yet both get roughly the same number of beats—100 million and change, spread over two years for the mouse and roughly 80 years for the whale. "There's this beautiful invariant: All living creatures have about the same amount of energetic life," Enquist says.

Yet while many animals outmass us humans, few outlive us. Why the long life for us lightweights? Like the hide of a rhinoceros or the claws of a tiger, human cleverness makes us tough to kill. That means random longevity-enhancing genes have a pretty good shot at evading natural selection. A bird that gets eaten in its second month of life never passes on whatever fluke mutation might have given it—and its progeny—an extra year or two.

As for the ecologists' neat mathematical equation, "primates are a little different," Enquist concedes. "For the number of heartbeats we have in our lives, we live a little longer than we should, and it's a big mystery why that is." He speculates that the difference for us outliers will be explained by brain size—or, rather, by how much time and energy humans spend growing their brains relative to the rest of their bodies. Why lavishing that extra energy on brainmaking translates into disproportionately long lives, Enquist isn't sure (and at 37, he has only about 36 more years to figure it out). Luckily, the same biological aberration that allows people to contemplate their own mortality is responsible, albeit indirectly, for delaying it. —SUSAN DOMINUS, *writer for* The New York Times Magazine

What causes gravity?

Isaac Newton first figured out the fundamental nature of gravity in the late 1600s. By unraveling the mysteries of planetary movement and Earth's pull on its inhabitants, he described modern physics. But more than three centuries later, that's still all we have: an understanding of the effect, with almost no grasp of the cause. Is gravity carried by an elementary particle? Is it some fundamental feature of spacetime we don't understand? Why can't gravity be reconciled with the better-understood quantum forces? All these questions remain unanswered. Many scientists think gravity must be generated by a massless particle, and have even dubbed it the graviton. But experiments to detect this entity (using a supercollider, for example) can't be performed with current technology. "To generate the energy required to investigate a gravity particle, we believe, would produce a black hole," says Harvard physicist Lisa Randall. "Space itself just breaks down." Right now, mathematics is the best investigative tool for getting gravity to square with subatomic forces like electromagnetism. But making the math work requires dealing with exotic string theory notions like invisible 10-dimensional space. "We've always understood that gravity was different," Randall says. "If we figure out why in the next 30 years, there will be another big, new question. I guarantee it." —JOHN HOCKENBERRY

OK, hitchhikers, you're right. This package contains only 40 great questions about life, the universe and everything. Got two more of your own? Send them our way at www.wired.com/42.

Why can't we regrow body parts?

Slice through your finger with a kitchen knife and it's bye-bye pinkie. But lop a leg off a salamander and it'll grow a new one with little more fuss than we expend on a broken nail. Scientists looking to reverse tissue damage caused by disease, injury, or aging want to know how the agile amphibians do it—and why we can't. ¶ When salamanders are wounded, skin, bone, muscle, and blood vessels at the site revert to their undifferentiated states, forming a spongy mass called a blastema. It's as if the cells go back in time and then retrace their steps to assemble a new organ or limb. ¶ We seem to have this same basic program written in our genes: As embryos, we grew arms, legs, heart, lungs, and so on with no problem, and even as adults, one type of cell in our nervous system can dedifferentiate to repair damage. Others in our liver show similar flexibility. But for the most part, our regenerative pathway appears to be roadblocked. The reason may be that the rapid cell division required to sprout a new limb looks to the body a lot like the unchecked growth of cancer. Our longevity makes us vulnerable to accumulated DNA mutations, so we've evolved molecular brakes to keep tumors at bay. In order to unlock our regenerative capabilities, scientists will have to figure out how to override the stop signals without sparking a malignant rampage. —ERIKA CHECK, *biology reporter for* Nature

Why do we still have big questions?

Information is expanding 10 times faster than any product on this planet—manufactured or natural. According to Hal Varian, an economist at UC Berkeley and a consultant to Google, worldwide information is increasing at 66 percent per year—approaching the rate of Moore's law—while the most prolific manufactured stuff—paper, let's say, or steel—averages only as much as 7 percent annually. By this rough metric, knowledge is growing exponentially. Indeed, the current pace of discovery is accelerating so rapidly that it seems as if we're headed for that rapture of enlightenment known as the Singularity.

FOR MORE: wired.com/extras

In fact, we may be nearly there. A decade ago, author John Horgan interviewed prestigious scientists in many fields and concluded in his book *The End of Science* that all the big questions had been answered. The world of science has been roughly mapped out—structure of atoms, nature of light, theories of relativity and evolution, and so on—and all that remains now is to color in the details.

So why do we still have so many unanswered questions? Take the current state of physics: We don't know what 96 percent of the universe is made of. We call it "dark matter," a euphemism for our ignorance.

Yet it is also clear that we know far more about the universe than we did a century ago, and we have put this understanding to practical use—in consumer goods like GPS receivers and iPods, in medical devices like MRI scanners, and in engineered materials like photovoltaic cells and carbon nanotubes. Our steady and beneficial progress in knowledge comes from steady and beneficial progress in tools and technology. Telescopes, microscopes, fluoroscopes, and oscilloscopes allow us to see in new ways and to know more about the universe.

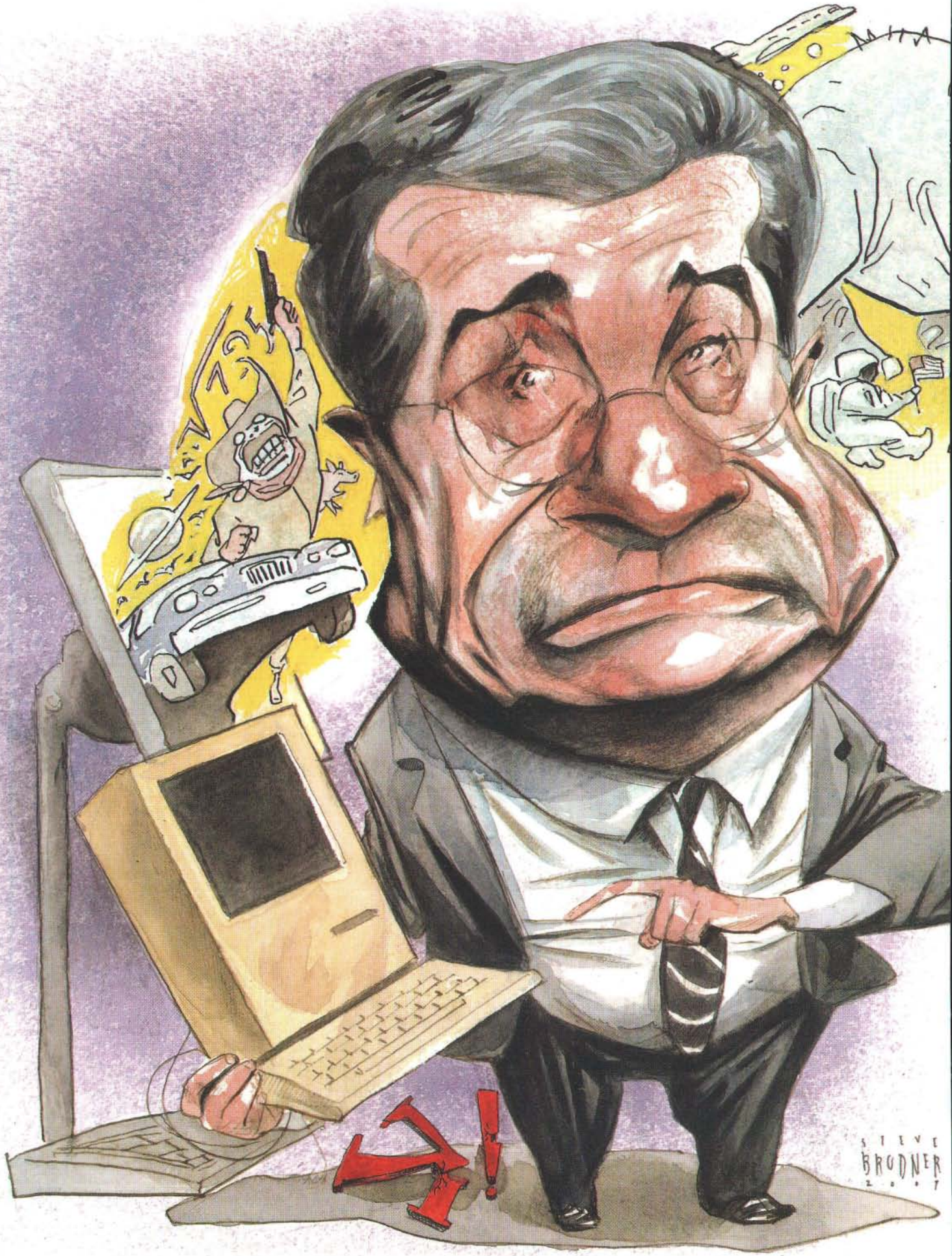
The paradox of science is that every answer breeds at least two new questions. More answers mean even more questions, expanding not only what we know but also what we don't know. Every new tool for looking farther or deeper or smaller allows us to spy into our ignorance. Future technologies such as artificial intelligence, controlled fusion, and quantum computing (to name a few on the near horizon) will change the world—that means the biggest questions have yet to be asked. —KEVIN KELLY, *author of* Cool Tools

Which is more important: nature or nurture?

Nature.






STEVE
BRODNER
2007



SELLING ADS AGAINST SEARCH—IT SEEMED LIKE SUCH A SIMPLE THING. BUT WHILE CEO TERRY SEMEL FUMBLED AND BUMBLED, GOOGLE PULLED AHEAD.

How Yahoo Blew It

BY FRED VOGELSTEIN

Terry Semel was pissed.

The Yahoo CEO had offered to buy Google for roughly $3 billion, but the young Internet search firm wasn't interested. Once upon a time, Google's founders had come to Yahoo for an infusion of cash; now they were turning up their noses at what Semel believed was a perfectly reasonable offer. Worse, Semel's lieutenants were telling him that, in fact, Google was probably worth at least $5 billion.¶ This was way back in the summer of 2002, two years before Google went public. An age before Google's stock soared above $500 a share, giving the company a market value of $147 billion—right behind Chevron and just ahead of Intel.

As Semel and his top staff sat around the table in a corporate conference room named after a Ben & Jerry's ice cream flavor (Phish Food), $5 billion sounded unacceptably high. Google's revenue stood at a measly $240 million a year. Yahoo's was about $837 million. And yet, with Yahoo's stock price still hovering at a bubble-busted $7 a share, a $5 billion purchase price would essentially mean that Yahoo would have to spend its entire market value to swing the deal. It would be a merger of equals, not a purchase.

Terry Semel—a legendary Hollywood dealmaker, a guy who didn't even use email—had not come to Silicon Valley to meekly merge with the geeky boys of Google. He had come to turn Yahoo into the next great media giant. Which might explain why the face of the famously serene CEO was slowly turning the color of Yahoo's purple logo, exclamation point included. "Five billion dollars, 7 billion, 10 billion. I don't know what they're really worth—and you don't either," he told his staff. "There's no fucking way we're going to do this!"

Semel could talk tough because he had a backup plan. Yahoo would go out and buy its own top-notch search engine and its own search-advertising technology, and it would beat Google in the emerging arena of little text ads that pop up next to search results. Semel's decision to opt for this plan B was a fateful one. It was a smart play—but Yahoo fumbled, bungled, and mishandled its execution at every step. (More on that in a moment.) As a result, Google today controls nearly 70 percent of the search-related advertising market, an industry worth more than $15 billion a year and growing at roughly 50 percent a year. It's these ads that are the source of Google's riches and the basis for its expanding power.

And what must infuriate Semel: This could have been Yahoo.

Laid low by the tech crash, Yahoo brought in Semel in May 2001, when the company was at its nadir. It rebounded spectacularly under his leadership, but 2006—a year expected by many to be Yahoo's best—turned out dismally. Brand-advertising growth fell by half, while Yahoo's share of search-related advertising dropped from 32 to 24 percent, according to Piper Jaffray. (During the same period, Google's edged up from 64 to 68 percent.) Analysts at Morgan Stanley predicted that operating profits at Yahoo would fall by 20 percent. (Final 2006 results had not posted by press time.) "It's now a given among advertisers that Google has won the search game," says Jeff Lanctot, vice president of media for Internet ad firm Avenue A Razorfish. No wonder Yahoo's share price fell 36 percent last year.

And the problems don't stop there. Semel's vaunted dealmaking skills seem to have deserted him. Sure, Yahoo snapped up some smaller companies in 2006 and formed partnerships with eBay and a consortium of newspapers. But when it came to the big acquisitions, deals that might have positioned the company for the new world of social networking and online video, Semel came up empty. A months-long dalliance with the social-networking darling Facebook ended in nothing more than a polite kiss on the cheek. Yahoo was interested in buying YouTube, but Google snatched away the Web video star for $1.65 billion.

Meanwhile, Yahoo's much-watched effort to create an entertainment unit in Hollywood fizzled. And its employment listings site, HotJobs, was trounced by the competition. In December, Semel shook up his top management team, leading to the departures of COO Dan Rosensweig and content chief Lloyd Braun and to the streamlining of the company's organizational chart. There's talk that Semel himself may be on the way out.

Worst of all, Yahoo's long-delayed push to aggressively compete in the search-driven advertising business is only now getting off the ground, arguably two years behind schedule. Semel bought a search engine in 2002 and a search-driven ad firm in 2003. All that was left to do was to put the pieces together.

At the end of 2001, few people were saying that there were billions to be made by serving up text ads every time an Internet user ran a search. But Bill Gross, the indefatigable entrepreneur behind the business incubator IdeaLab, was all over the concept. In 1998, he had launched a search site called GoTo.com. Other search engines promised results based on human-built directories or computer-driven algorithms. Gross' search site auctioned its results to the highest bidder.

At the time, the idea seemed radical, even offensive. Who would want results driven by hordes of sellers hawking goods and services? Advertisers would, as it turned out. Although GoTo never became a top-tier search destination, Gross and CEO Ted Meisel quickly saw that the big Web portals and search engines like AltaVista, Yahoo, AOL, and MSN would pay big money for GoTo's auction-driven results. They changed the name to Overture in

2001, and by the end of that year Web surfers had clicked on Overture ads 1.4 billion times. Advertisers understood the value of being able to bid for juicy keywords. The ads would be laser targeted, and the results—clicks—could be measured precisely. The portals and search sites figured out that the sponsored links could be placed alongside a more objective set of search results. It was a brilliant way to turn searches into revenue.

Google saw the power of this approach and decided to grow its own. Engineers at Google took the concept of pay-per-click search results and in 2002 turned it into a smooth-running, money-printing machine called AdWords. The company developed an automated process for advertisers to bid on keywords. It also made the auctions more sophisticated so customers couldn't game the system. Crucially, Google determined ad prominence on a Web page not just by the price advertisers were willing to pay per click—as Overture had done—but also based on how many clickthroughs that ad generated. As a result, Google's system responded quickly to ineffective ads: They disappeared. Google also had a massive database that tracked which ads worked and which didn't, information it could pass on to its customers to help them create better ad campaigns. By the time Google published its financial statements for the first time in 2004, everyone knew that the company had harnessed one of the great innovations of the Internet age.

All this is what prompted Semel to make his bid for Google. When that failed, he pushed ahead with plan B. In late 2002, Yahoo acquired Inktomi, which many believed had the second-best search technology on the planet. (Google was still tops.) The price: a bargain $257 million. Then, in mid-2003, Semel's patient negotiations with Overture bore fruit. He paid $1.4 billion for the search-driven ad pioneer, roughly 25 percent less than the original asking price.

Semel had his search engine, and he had his search-advertising technology. But rolling them into a money-making venture was harder than he and his execs had thought it would be. First, there were what are delicately described in business school as integration issues. Yahoo was the quintessential Silicon Valley startup. Founded by Stanford engineering students Jerry Yang and David Filo in a campus trailer in 1994, bootstrap innovation and hardcore coding were etched into its corporate DNA. Semel set out to modify that. He had to do a lot of internal politicking to convince his engineers that adapting

AP

Under Semel, Yahoo extended its depth and global reach, but it still couldn't compete against Google.



existing technology from Inktomi and Overture was better than building their own versions from scratch.

One way to convince the staff was to appeal to their killer instincts. So after both deals were announced, Semel promised that Yahoo would merge the three to produce a certifiable Google slayer. He told investors, customers, and employees that Yahoo would be the most trafficked site on the Internet, with the best search for consumers and the most effective advertising for customers. "We didn't get into search to do what everyone else was doing," he said back then. "We got into search to change the game."

By early 2004—more than a year after the deal—Yahoo had integrated Inktomi's technology well enough to put an end to a 2000 agreement to use Google's search technology. And by late summer, even as Google was preparing to go public, optimism about Yahoo's future was so high that its stock hit $36.42, eight times its low in 2001. The thinking went that Google's rapid growth rate and immature management would cause it to stumble, allowing Yahoo to prevail. At the time, Yahoo had a database of 157 million users that could be sliced and diced for advertisers to permit pinpoint targeting, while name brands like Procter & Gamble were skeptical about Google.

So far so good. But to pull off the second part of plan B, Semel needed to integrate Overture—the service that sold search keywords by auction and placed them on search-results pages. To start with, the service itself needed a major technological overhaul: The original technology had been created in a hurry during the boom, and it wasn't built to work on a global scale. Also, because of the way it was designed—to allow human review of each ad—it was painfully slow compared to Google. Meanwhile, executives and engineers in Sunnyvale were waffling over whether to merge Overture with Yahoo's operations or to let it remain a quasi-independent service.

It was a hard decision. Revenue from Yahoo's display-advertising business withered with the popping of the Internet bubble. Buying Overture had helped triple Yahoo's profits. No one wanted to mess that up. And then there was the inconvenient fact that Overture's biggest customer (after Yahoo itself) was Microsoft, representing 10 percent of Overture's revenue. Redmond was getting into the search game, too, and wouldn't have been happy about having one of its suppliers so closely associated with a competitor.

Yahoo executives tried to have it both ways. They attempted to placate Microsoft by maintaining Overture as a stand-alone brand. At the same time, they planned an overhaul of Overture's technology, a project code-named Panama. It was a disaster. With no clear delineations, Yahoo and Overture executives fought over turf. Yahoo hired and fired a half-dozen engineering chiefs at Overture during the first year. Overture salespeople competed for business with Yahoo salespeople. And Meisel, Overture's CEO, was ineffective—either inept or hamstrung by bureaucracy, depending on whom you ask. Decisions big and small, from trying out new features to agreeing on budgets, had to be cleared by committee after committee in Sunnyvale. "It was a clusterfuck," one of the participants says.

Semel doesn't appear to have recognized the depth of the problems until the fall of 2005, when Meisel was replaced by Jeff Weiner, a Semel protégé. Semel had decided in March 2005 to finally, fully integrate Overture into Yahoo, but those who worked on the project say it didn't become a truly top priority until Weiner took over. The dithering had done its damage, and by the end of 2005 anyone could see that Yahoo's search-advertising plans were in tatters. "All you had to do was look at Google's numbers compared to ours," says a former Yahoo search exec. When Yahoo decided it was going to buy Overture in 2002, Overture dominated search-related advertising; its revenue was two times Google's. By the time the deal was actually announced in 2003, the two companies were neck and neck. Two years later, Google's revenue was 2.5 times Overture's.

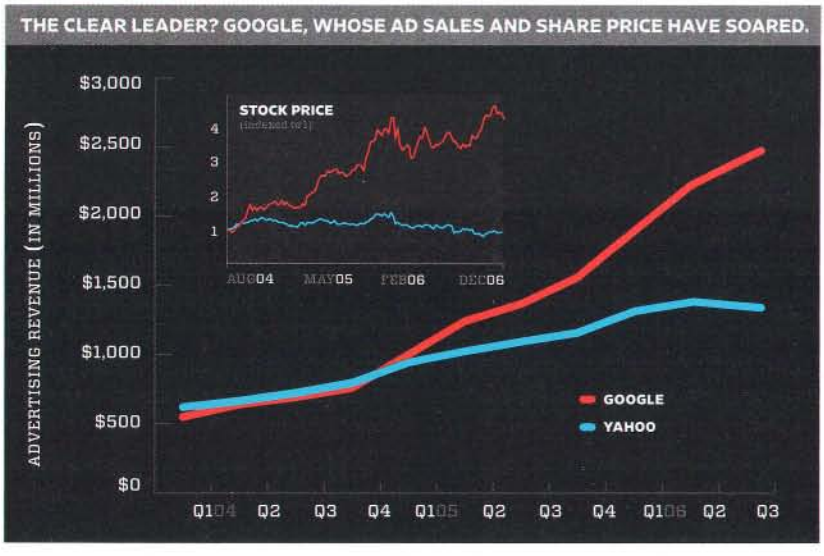
Weiner probably was the right executive to whip Panama into shape. He had performed brilliantly getting Yahoo's Inktomi-fueled search engine out the door in early 2004. But Yahoo was half the size back then, and Weiner had an easier time walling off his team from the rest of the company so it could develop a revamped technology. Now, with Yahoo carrying 10,000 employees and limping along with a semifunctional search-advertising system, holing up undisturbed turned out to be harder. If engineers wanted to try placing search ads on the homepage, the homepage team had to be consulted. If they wanted to experiment with the Yahoo news page, the news team had a voice.

And this project was more complicated than just knitting together a search engine with Yahoo's computer systems. It needed, among other things, a new easy-to-use interface for advertisers to navigate while placing their auction bids. While Google's AdWords service allowed customers to buy ads through a fully automated system, Overture's did not. Nor did Overture have an effective way to push advertising onto blogs with matching subject matter, as Google did.

Another problem was Overture's practice of displaying ads based solely on how much the advertiser had offered to pay per click. Unlike Google's system, Overture's wasn't designed to factor in how much traffic those ads might generate. This meant it was

Yahoo Falls Behind

THE CLEAR LEADER? GOOGLE, WHOSE AD SALES AND SHARE PRICE HAVE SOARED.



SOURCES: BLOOMBERG, GOOGLE, YAHOO

SEMEL RUNS YAHOO LIKE A MOVIE STUDIO: FIND STARS—BE THEY ACTORS OR ENGINEERS—AND USE THEM TO MAKE CONTENT THAT PEOPLE WANT.

more likely that expensive but irrelevant ads could end up at the top of the column marked "sponsor results." This sounds easy to fix, but it actually entails creating entirely new ranking software and a new database to keep track of millions of clicks on the fly.

And lastly, because Panama was going to handle billions of dollars of customer money, it needed to have billing and cash-management systems as reliable as a bank's. By the end of 2006, Yahoo had already spent three months transitioning advertisers to the new network, something that is to continue into March. "It's been like changing engines in an airplane mid-air without any of the passengers noticing," says Steve Mitgang, a senior VP at Yahoo.

Though Semel refused to comment for this article, the company did release a statement in response to the idea that Yahoo missed a prime opportunity to beat its rival, Google. "While we recognize in hindsight that certain challenges could have been addressed more rapidly, we've made substantial strides since then and believe we're in the best position ever to exploit Yahoo's considerable strengths," the statement reads, in part. "Sure, our timeline for Project Panama took longer than we had anticipated, but it's live now and we're very excited about it and the early feedback we're receiving. Most people outside of Yahoo aren't aware of the tremendous—in fact, heroic—effort that has taken place in our search advertising business over the past 18 months."

The problem, of course, is that better-late-than-never often fails in technology markets that operate as winner-take-all games. Just as Microsoft boxed out other operating systems in the 1980s and office software in the 1990s and eBay has largely outpaced other auction rivals, Google now dominates search-driven advertising. "They've hit a tipping point," says Peter Hershberg, managing partner of search-marketing firm Reprise Media. "People now use Google because everyone else is using Google."

Terry Semel has come full circle—and not in a good way. When he took over Yahoo in 2001, he was laughed at for being a technological neophyte. But the new CEO quickly silenced his doubters, streamlining the management structure, making savvy deals and acquisitions, and improving the company's image, earnings, and stock price.

Indeed, Semel has run the company like a souped-up movie studio: Find stars—be they actors or engineers—and use them to make content that people want to watch or use. Once you have the content—whether it's movies and TV shows or tools like email, search, and news—you sell it directly or sell advertising against it. His view of Yahoo's culture has always been that technology is an important thing but not the only thing. "Growing up, I didn't know how a television worked," he likes to quip. "I just knew you hit On." For all but the geekiest of geeks, that's a line that resonates. Most people can't explain how a TV works, but they understand how much pleasure and value they get from it.

The truth is that when Semel worked in Hollywood, he understood more about how movies and TV shows made it to theaters and TV sets than virtually anyone else on the planet. Early in his career, during stints in New York, Cleveland, and Los Angeles, all Semel did was sell movies to theater chain owners. He'd show up at each theater—there were only a handful of national chains then—with a list of the movies Warner was going to release over the next few months, and each owner would bid on the movies he wanted.

When Semel became co-CEO of Warner Bros. in the early 1980s, he was steeped in the marketing and distribution plumbing of Hollywood. So it's no surprise, in retrospect, that his legacy is as one of Hollywood's biggest innovators and risk takers. In the 1980s, it was Semel who pushed the idea of renting Warner's excess movie-distribution capacity to other moviemakers as a way of creating a more stable income stream. Almost every studio now has such an arrangement. In the 1990s, he and partner Bob Daly financed *Batman* and made merchandising an integral part of the way movies are financed and marketed. During Semel's tenure, revenue at Warner Bros. grew tenfold to more than $11 billion.

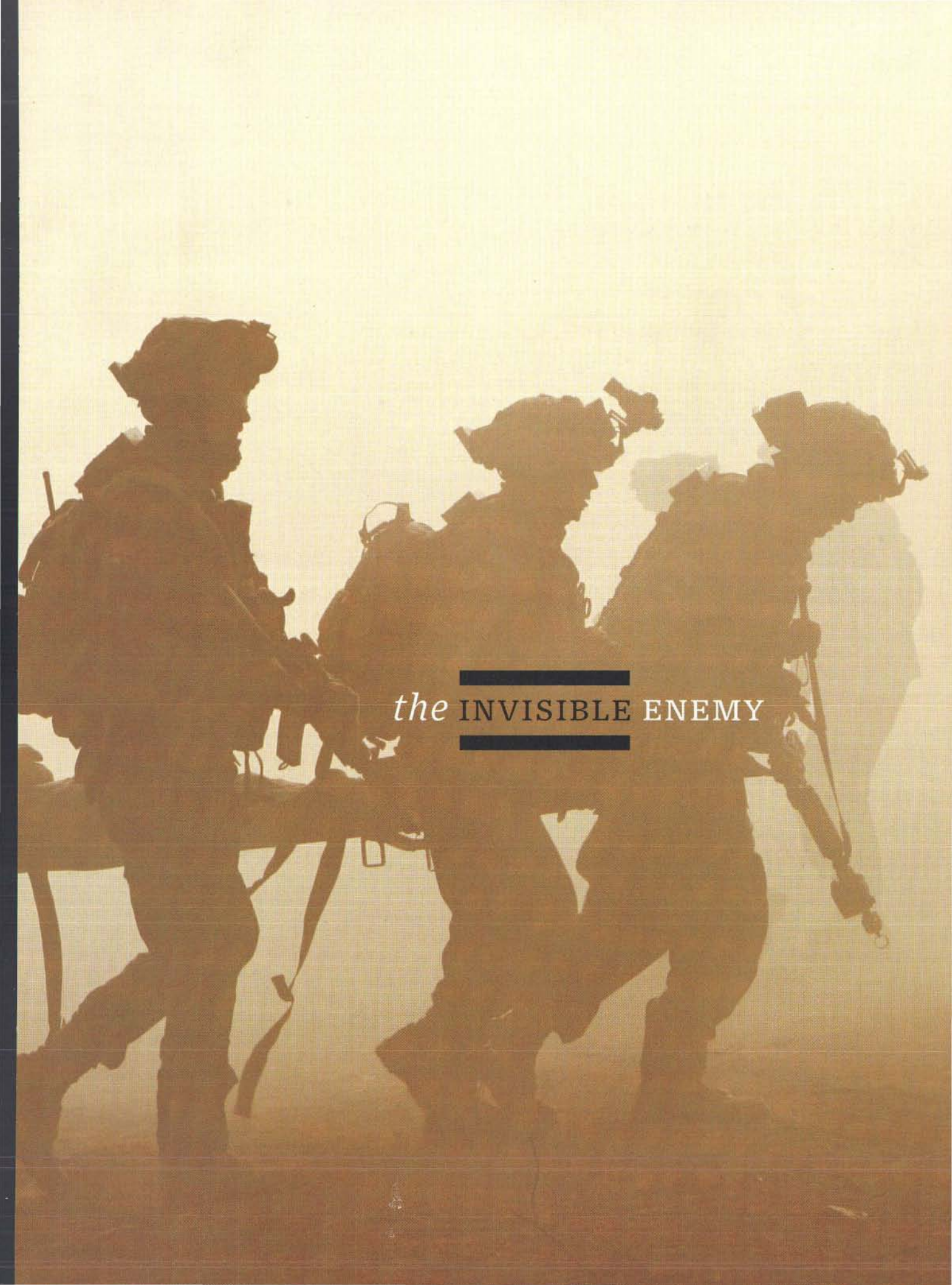
But now, despite Semel's achievements in Hollywood and early success at Yahoo, Silicon Valley is buzzing with a familiar refrain: Wouldn't an executive with a little more technology savvy be a better fit? Semel has been Yahoo's CEO for nearly six years, yet he has never acquired an intuitive sense of the company's plumbing. He understands how to do deals and partnerships, he gets how to market Yahoo's brand, and he knows how to tap Yahoo's giant user base to sell brand advertising to corporations. But the challenges of integrating two giant computer systems or redesigning a database or redoing a user interface? Many who have met with him at Yahoo say he still doesn't know the right questions to ask about technology. "Terry could never pound the table and say, 'This is where we need to go, guys,'" one former Yahoo executive says. "On those subjects, he always had to have someone next to him explaining why it was important." One could have made a convincing argument two years ago that such deep technical knowledge didn't matter much. But now we have empirical evidence: At Yahoo, the marketers rule, and at Google the engineers rule. And for that, Yahoo is finally paying the price. W

Contributing editor **FRED VOGELSTEIN** (fred_vogelstein@wired.com) *wrote about Microsoft in issue 14.10.*

The PENTAGON *created the perfect machine for saving the* LIVES *of soldiers wounded in* IRAQ. *But then GIs started getting* SICK. THE CULPRIT: *a drug-resistant* SUPERGERM *infecting the military's* EVACUATION *chain.*

by Steve SILBERMAN




the INVISIBLE ENEMY

A homemade BOMB

The operating room at Ibn Sina Hospital in Baghdad, an Army facility implicated in the spread of *Acinetobacter baumannii*. Below left: Jonathan Gadsden, who contracted the bug.

exploded under a Humvee in Anbar province, Iraq, on August 21, 2004. The blast flipped the vehicle into the air, killing two US marines and wounding another—a soft-spoken 20-year-old named Jonathan Gadsden who was near the end of his second tour of duty. In previous wars, he would have died within hours. His skull and ribs were fractured, his neck was broken, his back was badly burned, and his stomach had been perforated by shrapnel and debris. ¶ Gadsden got out of the war zone alive because of the Department of Defense's network of frontline trauma care and rapid air transport known as the evacuation chain. Minutes after the attack, a helicopter touched down in the desert. Combat medics stanched the marine's bleeding, inflated his collapsed lung, and eased his pain. He was airlifted to the 31st Combat Support Hospital in Baghdad, located in an old health care facility called the Ibn Sina, which had formerly catered to the Baathist elite. Army surgeons there repaired Gadsden's cranium, removed his injured spleen, and pumped him full of broad-spectrum antibiotics to ward off infection.



Three days later, he was flown to the Landstuhl Regional Medical Center in Germany, the largest American military hospital in Europe. He was treated for his burns, and his spine was stabilized for the 18-hour flight to the US. Just a week after nearly dying in the desert, Gadsden was recuperating at the National Naval Medical Center in Bethesda, Maryland, with his mother, Zeada, at his bedside.

The surgeons, nurses, medics, and pilots of the evacuation chain have saved thousands of lives. Soldiers wounded in Vietnam were six weeks of transit time away from US hospitals, and one out of every four of them died. By contrast, a soldier's odds of surviving battle injuries in Iraq are nine out of 10. Unfortunately, this remarkable advance in battlefield logistics has also resulted in an increase in the number of traumatically injured patients who are particularly susceptible to infections during their recovery. In Gadsden's case, from the moment he was carried into the Ibn Sina, the injured marine was in the crosshairs of an enemy he didn't even know was there.

At first, he did quite well. By early September, Gadsden was weaned off his ventilator and breathing on his own. For weeks he gradually improved. His buddies took him to a Washington Redskins game in his wheelchair, and the next day he navigated 50 feet with a walker. Soon Gadsden was transferred to a veterans' hospital in Florida called the James A. Haley Medical Center, where he offered to serve as the eyes of a fellow marine blinded in an ambush. The doctors told Zeada that her son might be able to go home by the end of October.

But he still had mysterious symptoms that he couldn't shake, like headaches, rashes, and intermittent fevers. His doctors gave him CT scans, laxatives, methadone, beta-blockers, Xanax, more surgery, and more antibiotics. An accurate evaluation of his case was difficult, however, because portions of his medical records never arrived from Bethesda. If they had, they would have shown a positive test for a kind of bacteria called *Acinetobacter baumannii*.

In the taxonomy of bad bugs, acinetobacter is classified as an opportunistic pathogen. Healthy people can carry the bacteria on their skin with no ill effects—a process known as colonization. But in newborns, the elderly, burn victims, patients with depressed immune systems, and those on ventilators, acinetobacter infections can kill. The removal of Gadsden's spleen and the traumatic nature of his wounds made him a prime target.

On October 17, the marine was given a day pass to accompany his mother to Wal-Mart, where he bought her a purse. Hours after returning to the hospital, his condition deteriorated abruptly. His heart rate and blood pressure were elevated, and his white blood cell count was spiking. Nurses noted in his chart that he had become "disoriented to place, time, and people ... thinking he is at home ... sitting up thinks he's lying down." He struggled through occupational therapy the following morning, shivering and complaining of the cold.

Gadsden had a seizure and a heart attack the next day. The neurology team discovered that his cerebrum and cerebellum had swelled up overnight; he was clinically brain-dead. His family and minister were called to the hospital, and on October 22 he was taken off life support.

The Marine Corps public affairs office sent out the customary press release attributing Gadsden's death to "injuries as a result of enemy action." But then a few weeks later, Zeada's dentist told her a Florida newspaper was reporting that her son had died of bacterial meningitis. Aided by US representative Bill Young, Zeada—who works as a cardiac-care technician in South Carolina—demanded an investigation.

She discovered that an autopsy was performed shortly after her son's death. The coroner recorded the "manner of death" as "homicide (explosion during war operation)" but determined the actual cause of death to be a bacterial infection. The organism that killed Gadsden, called *Nocardia*, had clogged the blood vessels leading to his brain. But the acinetobacter had been steadily draining his vital resources when he could least afford it. For weeks, it had been flourishing in his body, undetected by the doctors at Haley, resisting a constant assault by the most potent antibiotics in the medical arsenal.

"No one said that my son had anything like that," Zeada says. "I never had to wear gloves or a mask, and none of the nurses did either. No one had any information."

OPENING SPREAD: RICK WILKING/REUTERS/CORBIS; ALAN HAWES; PETER VAN AGTMAEL/POLARIS



Since OPERATION *Iraqi Freedom*

began in 2003, more than 700 US soldiers have been infected or colonized with *Acinetobacter baumannii*. A significant number of additional cases have been found in the Canadian and British armed forces, and among wounded Iraqi civilians. The Armed Forces Institute of Pathology has recorded seven deaths caused by the bacteria in US hospitals along the evacuation chain. Four were unlucky civilians who picked up the bug at Walter Reed Army Medical Center in Washington, DC, while undergoing treatment for other life-threatening conditions. Another was a 63-year-old woman, also chronically ill, who shared a ward at Landstuhl with infected coalition troops. ¶ Behind the scenes, the spread of a pathogen that targets wounded GIs has triggered broad reforms in both combat medical care and the Pentagon's networks for tracking bacterial threats within the ranks. Interviews with current and former military physicians, recent articles in medical journals, and internal reports reveal that the Department of Defense has been waging a secret war within the larger mission in Iraq and Afghanistan—a war against antibiotic-resistant pathogens.

Acinetobacter is only one of many bacterial nemeses prowling around in ICUs and neonatal units in hospitals all over the world. A particularly fierce organism known as MRSA—methicillin-resistant *Staphylococcus aureus*—infects healthy people, spreads easily, and accounts for many of the 90,000 fatal infections picked up in US hospitals each year. Another drug-resistant germ on the rise in health care facilities, *Clostridium difficile*, moves in for the kill when long courses of antibiotics have wiped out normal intestinal flora.

Forerunners of the bug causing the military infections have been making deadly incursions into civilian hospitals for more than a decade. In the early 1990s, 1,400 people were infected or colonized at a single facility in Spain. A few years later, particularly virulent strains of the bacteria spread through three Israeli hospitals, killing half of the infected patients. Death by acinetobacter can take many forms: catastrophic fevers, pneumonia, meningitis, infections of the spine, and sepsis of the blood. Patients who survive face longer hospital stays, more surgery, and severe complications.

Nevertheless, the bug makes an unlikely candidate for the next mass plague. It preys exclusively on the weakest of the weak and the sickest of the sick, slipping into the body through open wounds, catheters, and breathing tubes. Colonization poses no threat to people who aren't already ill, but colonized health care workers and hospital visitors can carry the bacteria into neighboring wards and other medical facilities. Epidemiologist Roberta Carey at the Centers for Disease Control and Prevention calls acinetobacter the Rodney Dangerfield of microorganisms: "It doesn't get a lot of respect because it's not out there bumping off normal, healthy people." But lately the bacteria has been getting its due, because it is rapidly evolving resistance to all of the antibiotics that used to keep it in check.

Until a few years ago, most strains could be dispatched with a wide variety of drugs. For the most tenacious infections, doctors could rely on a family of ultrabroad-spectrum antibiotics called carbapenems. But strains of acinetobacter are emerging now that are immune to every known remedy. Multidrug-resistant pathogens are an epidemiologist's nightmare—reminders of the dark ages when millions of people died every year of runaway infections.

"We've been looking at acinetobacter in real time for years and years in our lab," says John Quinn, scientific director of the Chicago Infectious Disease Research Institute. "Then all of a sudden in 2005, we started seeing more bugs that were resistant to the carbapenems. First one out of 10 bugs, then four out of 10, and then almost all of the bugs. So there's a new sheriff in town. That's a clinical disaster."

To battle these new strains, clinicians are being forced to dust off a World War II-era relic called colistin, which is so toxic that it causes kidney damage in as many as one in four patients who take it. In 2004, the Infectious Diseases Society of America included acinetobacter on its "bad bugs, no drugs" short list of pathogens that are "raising significant public health concerns." According to a recent CDC study, the new multidrug-resistant organisms are almost four times more deadly than older strains.

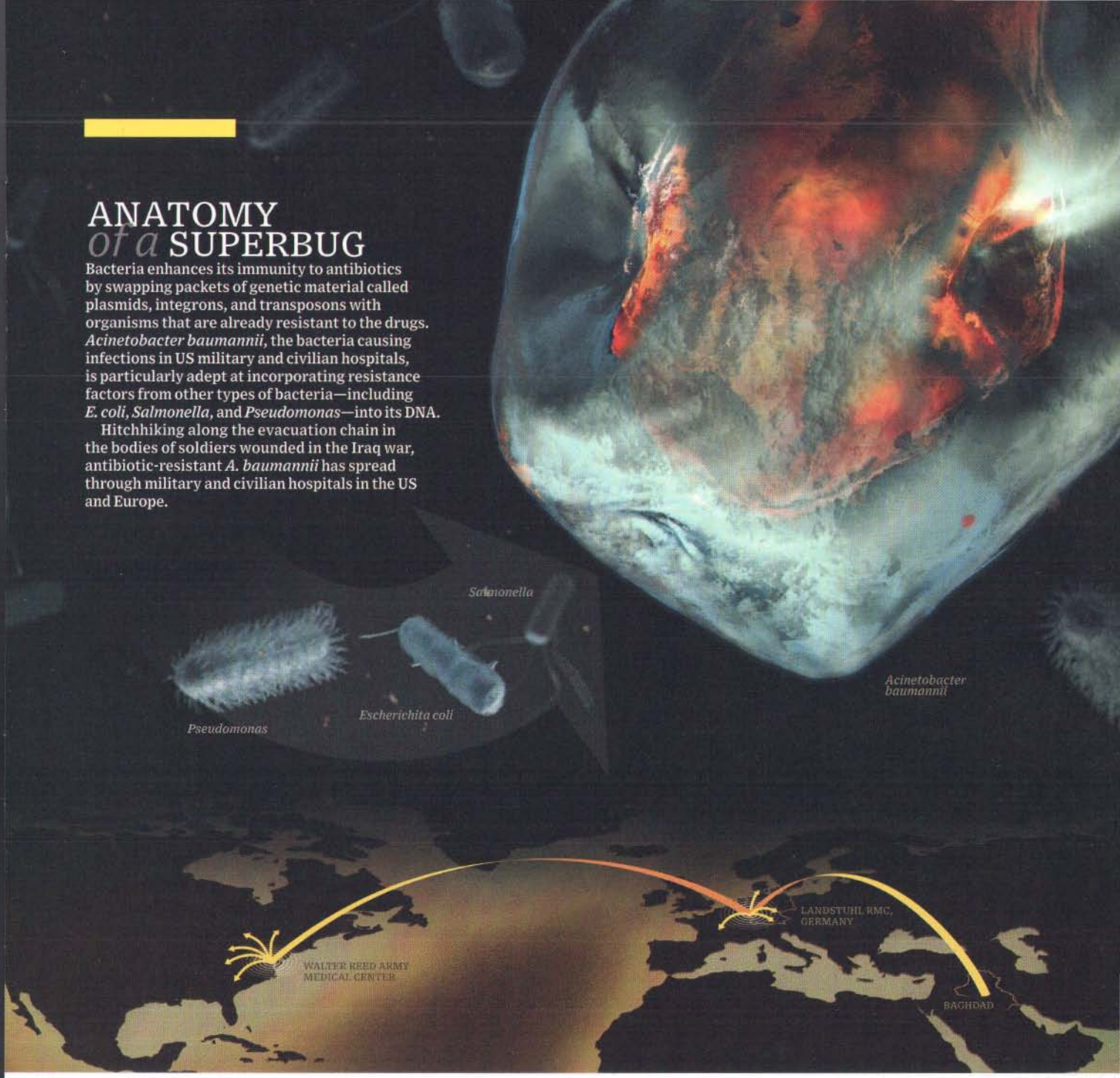
> *"These bacteria are developing very,* VERY QUICKLY, *"* *says CDC epidemiologist Arjun Srinivasan.* "THE BAD NEWS IS *that we're many years away from having new drugs to treat them. It should be* A CALL TO ARMS."

And they're spreading fast. A major outbreak in Chicago two years ago infected 81 patients, killing at least 14. Arizona health officials tracked more than 200 infections in state hospitals early last year. Doctors at Vanderbilt University Medical Center in Tennessee used to see an infection or two every year; now it's one or more a month. "These bacteria are developing very, very quickly," says CDC epidemiologist Arjun Srinivasan, who has been consulting with the DOD about the military outbreak. "The bad news is that we're many years away from having new drugs to treat them. It should be a call to arms."

ANATOMY *of a* SUPERBUG

Bacteria enhances its immunity to antibiotics by swapping packets of genetic material called plasmids, integrons, and transposons with organisms that are already resistant to the drugs. *Acinetobacter baumannii*, the bacteria causing infections in US military and civilian hospitals, is particularly adept at incorporating resistance factors from other types of bacteria—including *E. coli*, *Salmonella*, and *Pseudomonas*—into its DNA.

Hitchhiking along the evacuation chain in the bodies of soldiers wounded in the Iraq war, antibiotic-resistant *A. baumannii* has spread through military and civilian hospitals in the US and Europe.



I VISITED WALTER REED in 2004 to write about anesthesia on the front lines. As I spoke with an Army sergeant who had survived a brutal attack in Najaf, US senator John McCain and talk-radio host Don Imus came into the room to thank him for his service. When we walked out, McCain's assistant whipped out a bottle of sanitizing gel and passed it around. A nurse explained to me, "It's this bug that grows in the soil over there and gets blown into their wounds by IEDs. These poor guys are covered with it. Around here we call it Iraqibacter." Rumors were circulating at the hospital that insurgents dosed their homemade bombs with the flesh of dead animals.

Nearly four years into the war, the notion that deadly bacteria is lurking in the Iraqi dirt is still proposed by DOD officials as the most likely explanation for the military infections. In November, Duane Hospenthal, an infectious-disease expert at Brooke Army Medical Center in Texas and a consultant to the Army Surgeon General, said, "The question really has been: Is it coming from these old facilities we're using in Iraq? Is it coming from some of the Iraqi patients we have? Is it normal flora for our deployed soldiers who have been there for a while? Or is it being blown into them from shrapnel, dirt, and other materials by these explosive devices?"

Hospenthal added that he believes there is little cause for concern. "It's a low-grade, low-virulence pathogen that can be recovered from soil and water. Without having it blasted into you or your being immunocompromised, it's not going to hurt you. We still see acinetobacter, but now that it's been recognized, people

GRAPHIC BY **Bryan Christie**



Wounded soldiers are loaded for evacuation at Balad Air Base. Red lights indicate that the base is under attack.

LYNSEY ADDARIO/CORBIS

are less excited about it here. It's hard for me to even understand if this is a big issue."

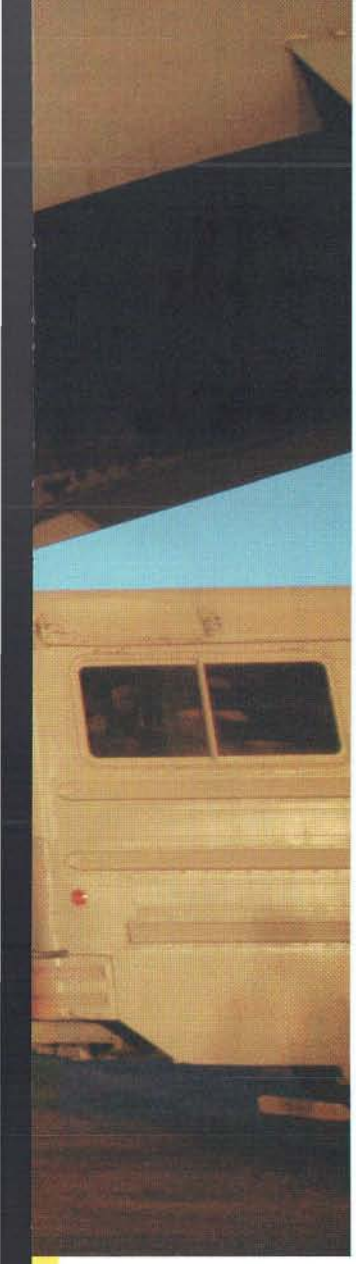
It's true that many species of acinetobacter flourish widely in the environment. Thriving colonies have been recovered from soil, cell phones, frozen chicken, wastewater treatment plants, Formica countertops, and even irradiated food all over the world. But the particular species causing the military infections, *baumannii*, is almost always found in just one environment—hospitals.

Lenie Dijkshoorn, a senior researcher at Leiden University Medical Center in the Netherlands, has studied the bug since 1984. "My colleagues and I have been looking for *Acinetobacter baumannii* in soil samples for years, and we haven't found it," she says. "These organisms are quite rare outside of hospitals."

In fact, they are supremely adapted to life in critical-care facilities. They can survive for weeks on a stethoscope, a blood-pressure cuff, a mattress, or a computer keyboard. The short, plump, rod-shaped bacilli are so adept at mining nutrients from recalcitrant sources that Israeli geneticists have engineered strains to biodegrade oil spills. Even before the bug evolved resistance to multiple antibiotics, it knew its way around a sponge and bucket. A Norwegian microbiologist noted in 1973 that disinfectant used to clean catheters in a gynecologist's lab "contained a veritable culture of the strain."

Hospenthal also told me that the acinetobacter has been recovered from the skin of those who have never been to war: "We've swabbed nondeployed soldiers and found the bacteria in their toe webs and other parts of their bodies." The study he was referring to, however, published last July in the journal *Infection Control and Hospital Epidemiology*, pointed out that those organisms were genetically very different from the bacteria infecting men and women evacuated from Iraq. The *Acinetobacter baumannii* colonizing new enlistees in Texas was still susceptible to antibiotics; the organisms infecting veterans are highly resistant.

In Europe, multidrug-resistant acinetobacter is spreading through civilian hospitals, precipitating a public health crisis. A 2003-2004 epidemic hit more than 50 hospitals and long-term care facilities in France, making scores of patients sick and killing 34 people. Thirty-nine infected patients died at St. Mary's Hospital in London two years ago.



"Put EVERYTHING *in the laundry right away. Don't touch this stuff. Don't* BREATHE *around it. It's got that bug the guys are bringing* BACK FROM IRAQ."

British health care officials are deeply concerned about a possible link between the civilian outbreaks and coalition troops carrying the bacteria home from Iraq. The UK's Health Protection Agency sent out a notice in 2003 asking doctors to submit samples of acinetobacter "from patients known to have returned from Iraq, or from patients on a ward where there have been Iraq returnees" to a lab for genotyping. Three months ago, a health official in England told *The Independent* that the same strain of bacteria infecting troops had been implicated in at least three civilian outbreaks. Prime minister Tony Blair recently announced that a major civilian hospital will open a ward just for military patients.

Bacteria that know how to disable or block the efficacy of multiple drugs are highly educated organisms. They're typically the product of an environment where antibiotics are in frequent use, and they have downloaded genetic cheat codes from other resistant bacteria into their own DNA. Multidrug-resistant staph, for example, hijacked genes from a bug called *Enterococcus* that have made it resistant to vancomycin—the drug of last resort. Once a strain acquires these upgrades, Darwin's selective pressure weeds out the late adopters.

FOR MORE: wired.com/extras

So where are these highly educated military bugs coming from? "It would be very interesting," Dijkshoorn says, "to investigate the routing of these patients."

THE FIRST NEWS that US troops had engaged an unforeseen enemy in Iraq appeared on a physicians' email list called ProMED on April 17, 2003. A communicable-disease expert in the Navy named Kyle Petersen posted a request for information about unusual infections he was seeing aboard the USNS *Comfort*, a 1,000-bed hospital ship off the coast of Kuwait.

The *Comfort* was taking in 50 new patients a day by helicopter, many of them Iraqi civilians and prisoners of war. Petersen told the ProMED list that he had seen "several cases of [multidrug-resistant] acinetobacter amongst Iraqi natives wounded by gunshots, shrapnel, burns or motor vehicle accidents." Reviewing the literature, he found reports of an outbreak in Turkish hospitals after an earthquake in 1999, which suggested to him that "acinetobacter species are fairly common pathogens in traumatic wounds, especially if they are dirty." The bugs on the *Comfort*, however, were more resistant than the Turkish strains. He continued: "Can anyone familiar with the soil biology of Iraq or the drug prescribing practices of the pre-regime medical system explain the severe drug resistance pattern we are seeing among our trauma victims medevaced from Iraq? Any comments would be greatly appreciated."

The bug's emergence on the *Comfort* made a tough job even tougher. In infected burn victims, skin grafts failed. Two Iraqi patients died. Luckily, the acinetobacter on the *Comfort* was still susceptible to imipenem, one of the carbapenem-based "magic bullets" kept in reserve for the day when nothing else works. The staff quickly ran through its stock of the drug, firing off urgent requests for more. By isolating carriers in an area of the ship nicknamed Acinetobacter Alley and maxing out the imipenem, the medics finally brought the spread of the bacteria under control.

Soon, however, the bug started popping up in other hospitals along the evacuation chain. More than 70 patients at Walter Reed eventually contracted acinetobacter infections of the blood. Other infected patients and carriers surfaced at Landstuhl, Bethesda, and Balad Air Base, the embarkation point for troops on their way out of Iraq. By early 2005, nearly one-third of the wounded soldiers admitted to the National Naval Medical Center had been colonized by the bacteria. Only a handful of the early cases could be traced directly to the bugs on the *Comfort*, because the ship steamed out of the Gulf three months into the war. But almost all of the infected patients and carriers had received medical care at field hospitals in Iraq.

Known as combat support hospitals or CSHs, these facilities had been hastily erected in tents and other temporary structures, in keeping with the Pentagon's goal of a lean and mobile fighting force. Maintaining sterile conditions in the desert required creative efforts. Sand blew through every available opening in the walls, and the 130-degree days took their toll on drugs, power supplies, and diagnostic equipment. To move trauma care closer to the action, the DOD deployed modified shipping containers called ISO boxes as portable operating rooms. It was standard procedure to have a dozen nurses, surgeons, and anesthesiologists in each box crowded around two patients undergoing surgery simultaneously—an infection risk in any hospital.

At the 28th CSH near Camp Dogwood—home to more than 4,000 US and British soldiers—there was only one washer and dryer to launder all of the linen, including the surgical scrubs. Army nurses reported to the DOD that "sheets | CONTINUED ON PAGE 148

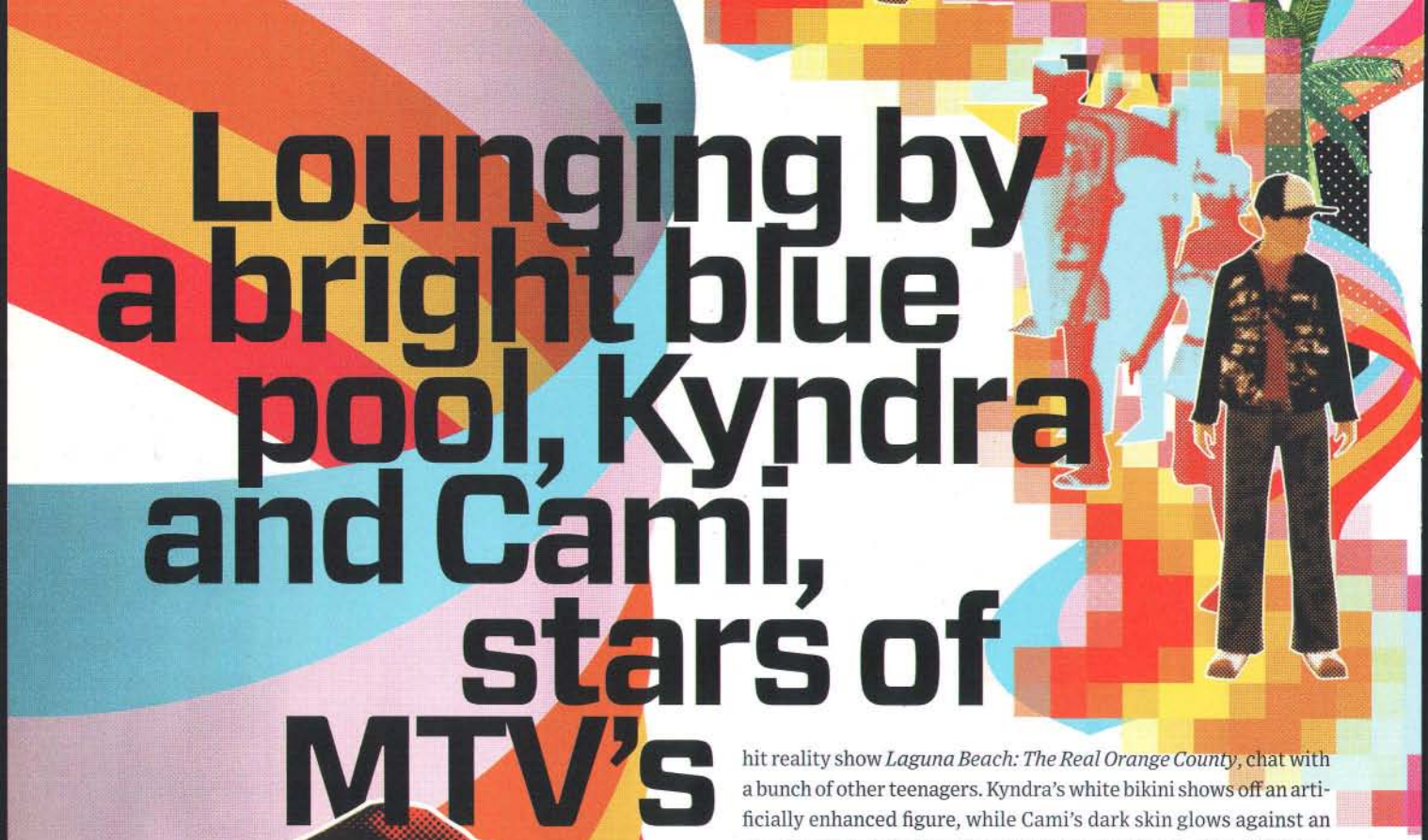


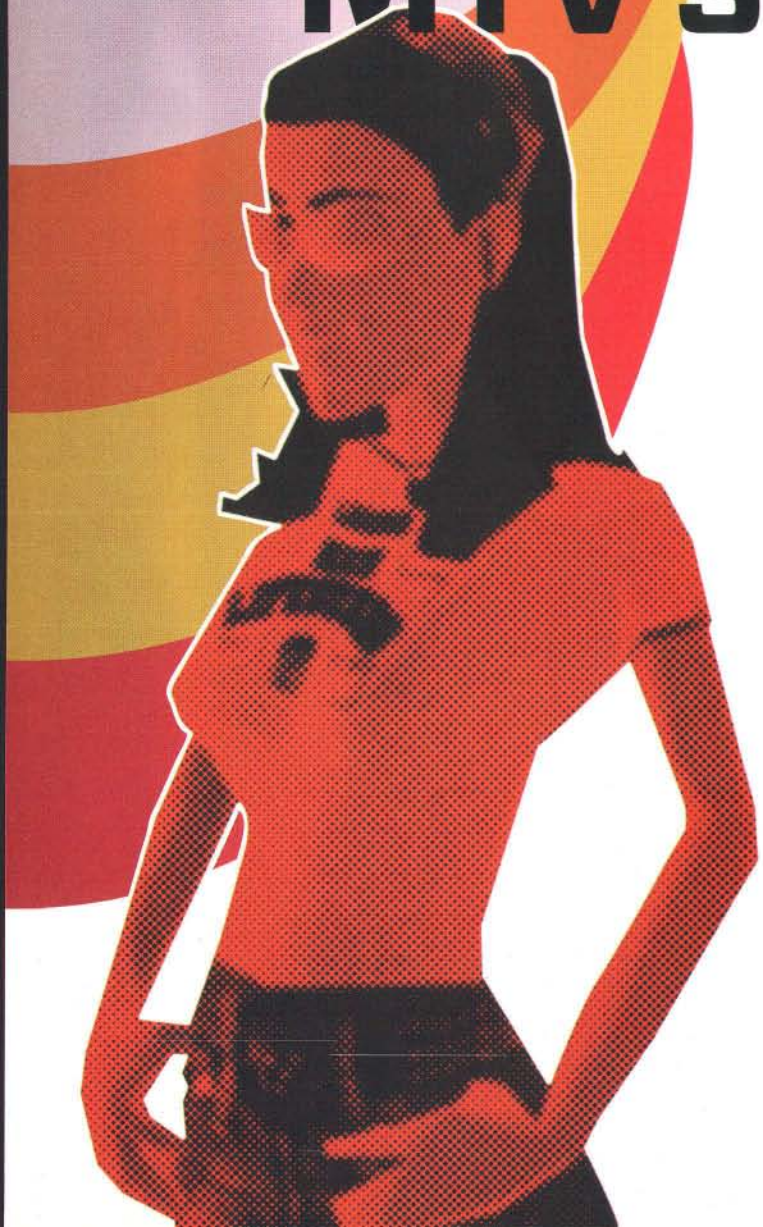


It used to be the last word in youth culture. Now MTV is more about reality shows than rock stars. Can a virtual world of 3-D avatars help the network get its groove back?

BY MARK WALLACE | ILLUSTRATION BY SEAN McCABE

Lounging by a bright blue pool, Kyndra and Cami, stars of MTV's





hit reality show *Laguna Beach: The Real Orange County*, chat with a bunch of other teenagers. Kyndra's white bikini shows off an artificially enhanced figure, while Cami's dark skin glows against an unnaturally bright blue sky. This is Laguna Beach, after a fashion, but it isn't the TV show. It's a live appearance, a chance for the show's bitchiest characters to hang with some of the 2 million viewers who tune in to their breakups and hookups every Wednesday night. As the pool fills up with fans, someone asks why the girls are always so mean to fellow cast member Tessa. Kyndra shrugs: "We just don't like her personally." Cami can't be bothered to answer; she's busy tongue wrestling with some hipster dude in sunglasses.

Kyndra and Cami are kind of fake—and not just in the catty teenage sense of the word. The two girls by the pool are computerized 3-D replicas of the cast members, who are using mouse and keyboard to navigate their avatars through a multiplayer online environment known as Virtual Laguna Beach. Anyone with a PC and a broadband connection can join them.

You want your MTV? These days, that means going virtual.

MTV planted its flag on the moon on August 1, 1981, and the channel quickly came to define what being young and hip was all about. The quick-cut style of the music video set the pace of the era and helped launch the careers of directors like Spike Jonze and Michel Gondry. In addition to being the official soundtrack of youth culture, the network discovered up-and-coming talent like animator Mike Judge, pioneered reality television with *The Real World*, and, with its televised town halls, helped send Bill Clinton to the White House in 1992.

But as anyone will tell you, MTV has lost its groove. The network's 2006 Video Music Awards were the lowest rated in 10 years. Its airtime is increasingly occupied by reality shows. You can find music on offshoot MTV2, but even so, TV commercials break more new bands these days. As an arbiter of cool, MTV has lost its clout.

MTV has always struggled to stay hip. "The novelty of music video wore off a year or two into our history," says Van Toffler, president of MTV Networks' music group. But over the last decade, the network has had an especially hard time keeping on top of the latest trends.

Why? The Internet killed the video star. Since the advent of Napster, MP3 blogs, and YouTube, kids have learned about new music by going online. They watch, buy, stream, swap, and steal music online. They list their favorite tracks and debate which band is coolest online.

Now MTV execs are scrambling to catch up with the hot new hangout spots on the Web. The network's parent company, Viacom, had a chance to buy MySpace, but competitor News Corp. snapped it up for $580 million in 2005. (A corporate reshuffle at Viacom followed.) MTV has been reduced to copycat initiatives. Last May, MTV beta-launched the subscription-based music-download service Urge to compete with Apple's iTunes. It continues to beef up Overdrive, a broadband site offering free music videos and show outtakes that vainly tries to compete with YouTube. The shows also have discussion forums—but they aren't holding on to as many eyeballs as the network would like. "Kids were watching *Laguna Beach*," says Matt Bostwick, an MTV senior vice president, "but then they were going everyplace else on the Web to talk about what they'd just seen."



These overhyped, underperforming MTV.com portals may, however, soon be overshadowed by a tiny unit within the network called Leapfrog. Its mission: Don't try to compete directly with today's top destinations. Instead, find the next big thing so MTV can, yes, leapfrog the competition once social networking sites start to seem *so* five minutes ago.

Bostwick, 48, is a leader of the Leapfrog initiative. The veteran marketing exec commutes from suburban Connecticut to his Dilbert-drab office in midtown Manhattan, but he's also a gamer who dresses like Johnny Cash: ankle-high black motorcycle boots, black jeans, and black shirt with black stripes. He's betting that 3-D environments like Virtual Laguna Beach are the next logical step beyond what he calls the classical model of 2-D social networking sites.

And he's probably right. What YouTube and MySpace offer—the ability to actively participate, build a social network, and express yourself by adding your own content—is now a minimum requirement for any Web-based property that wants to capture youth. And virtual worlds like Second Life push this sort of online socializing a step further. There, your interactions unfold in real time and take the form of a 3-D avatar that is more expressive than any flat Web site could ever be.

With its headlong leap into virtual worlds, MTV hopes to forge MySpace 2.0—and find its way back to the cutting edge. "It's like the moment you went from listening to music to watching it," Bostwick says. "Now we're taking it from watching the show to actually becoming the show."

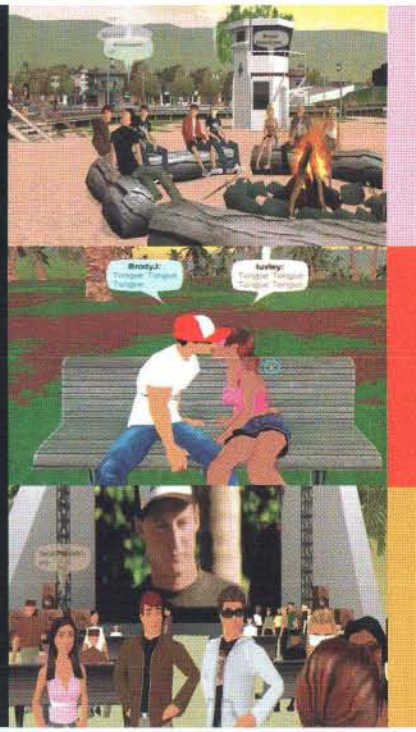
Bostwick is showing me his maroon Cadillac convertible. "It's not really made for this kind of driving," he says. He pushes the up arrow on his keyboard to make the Caddy go forward, but it stalls out and slides down the heavily banked curve of a virtual rally course. Bostwick has traded in his all-black wardrobe for a flattering micro-miniskirt—a fetching choice on the female avatar he chose for the purposes of this test-drive. When he pulls the Caddy over, it attracts the attention of a guy in board shorts and a hoodie who jumps into the passenger seat beside the newly buxom Bostwick. The MTV exec ejects his suitor with a mouseclick. "Everybody wants one of these," he says, grinning.

Bostwick has been mixing mediums in his marketing for a while. At Coca-Cola in Japan several years ago, he worked on vending machines that rang up the cell phones of passersby and let them download Coke ringtones, then offered them free beverages. When he came to MTV in 2004 to help upgrade "off-TV activities," Bostwick envisioned something similar to existing interactive worlds, like Neopets, and dreamed up an MTV-branded networked environment that kids could explore with a personalized avatar, a world that knew their tastes and purchase history, and one they could check in on using TV, Web pages, and mobile phones.

When Bostwick pitched his ambitious vision of an avatarized environment, the network still hadn't fully embraced the Web. But Toffler's reaction was: "That's the scariest shit I've ever seen, man. Let's do it!"

Leapfrog was born, and its first venture would be tied to *Laguna Beach*, one of MTV's top-rated shows. In March of 2006, the Leapfrog team started building a CG facsimile of the already surreal SoCal world of perfect bodies and obscene affluence using the technology that underpins There.com—a popular 3-D socializing space created by Makena Technologies. Compared to unfettered, user-generated worlds like Second Life, There.com gives users much less leeway to create their own objects, but it runs more smoothly, looks prettier, and gives developers tighter control over the economy and the behavior of visitors—it was a perfect fit for MTV.

First we went from hearing music to watching it. Now we're going from watching the show to being the show.



Scenes from Virtual Laguna Beach, where kids can hang out on the beach, change their dollars into the local currency, shop for clothes, chat, smooch, or even kick back and watch MTV shows.

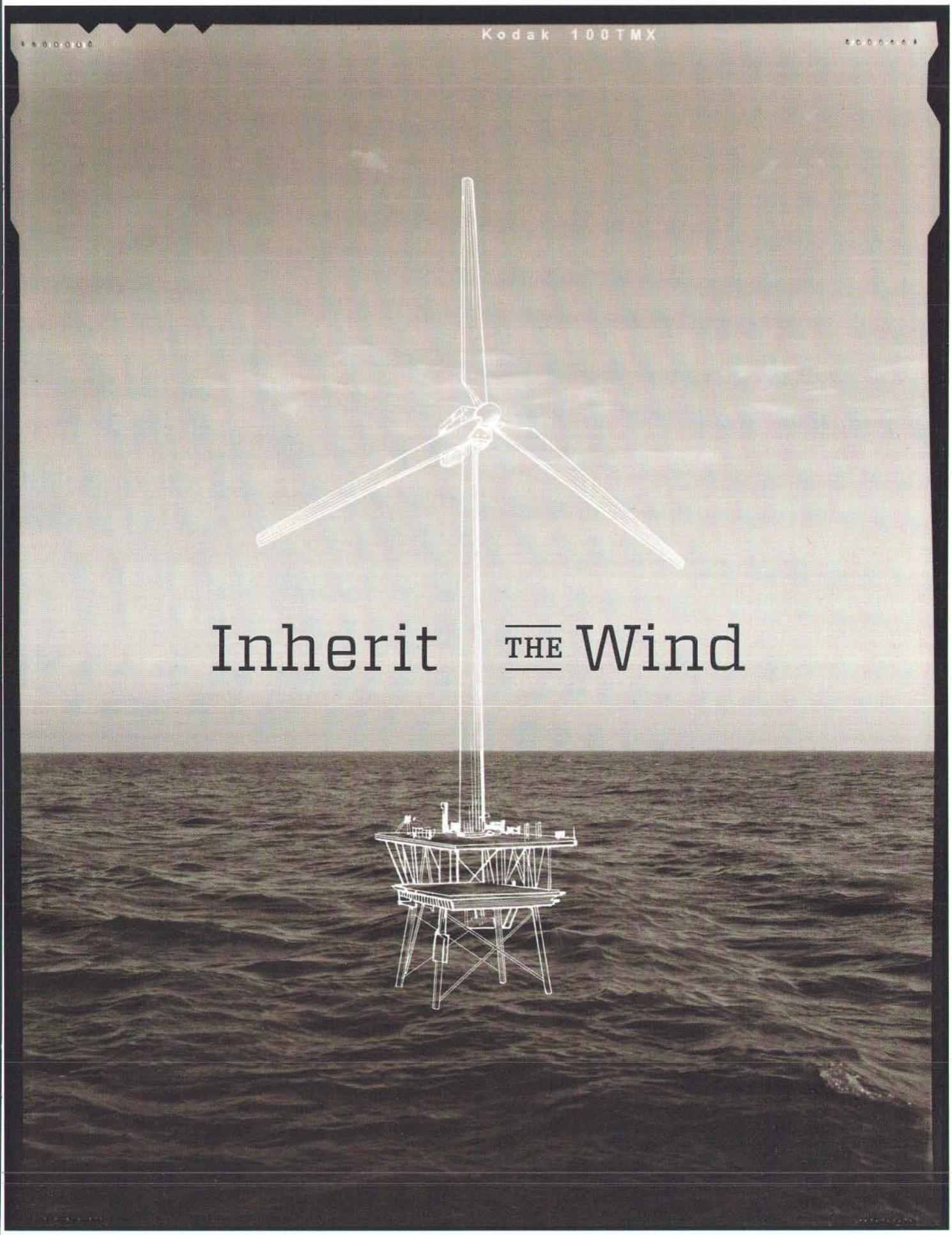
Virtual Laguna Beach officially launched in September and drew almost 300,000 sign-ups in its first 10 weeks. (It took Second Life three years to attract that many members.) Just register on the Web site for free membership, download the application, pick your outfit (low-rider jeans? sundress? cowboy hat?), and you're a virtual teenager loping along the beach. Every character you meet there is just like you: a cute, youthful avatar steered by a real person. If Second Life is like an anarchic frontier town, VLB is like Disney's Frontierland.

Visitors to VLB can text-chat with each other, go dancing at a club, throw a party, or just whiz through the | CONTINUED ON PAGE 152



THE GULF COAST IS LITTERED WITH THE CARCASSES OF UNUSED OIL EQUIPMENT. NOW THOSE STRUCTURES ARE BEING REPURPOSED TO BUILD THE FIRST OFFSHORE WIND FARM IN THE UNITED STATES. *by* John Geoghegan

PHOTOGRAPHS BY DAN WINTERS



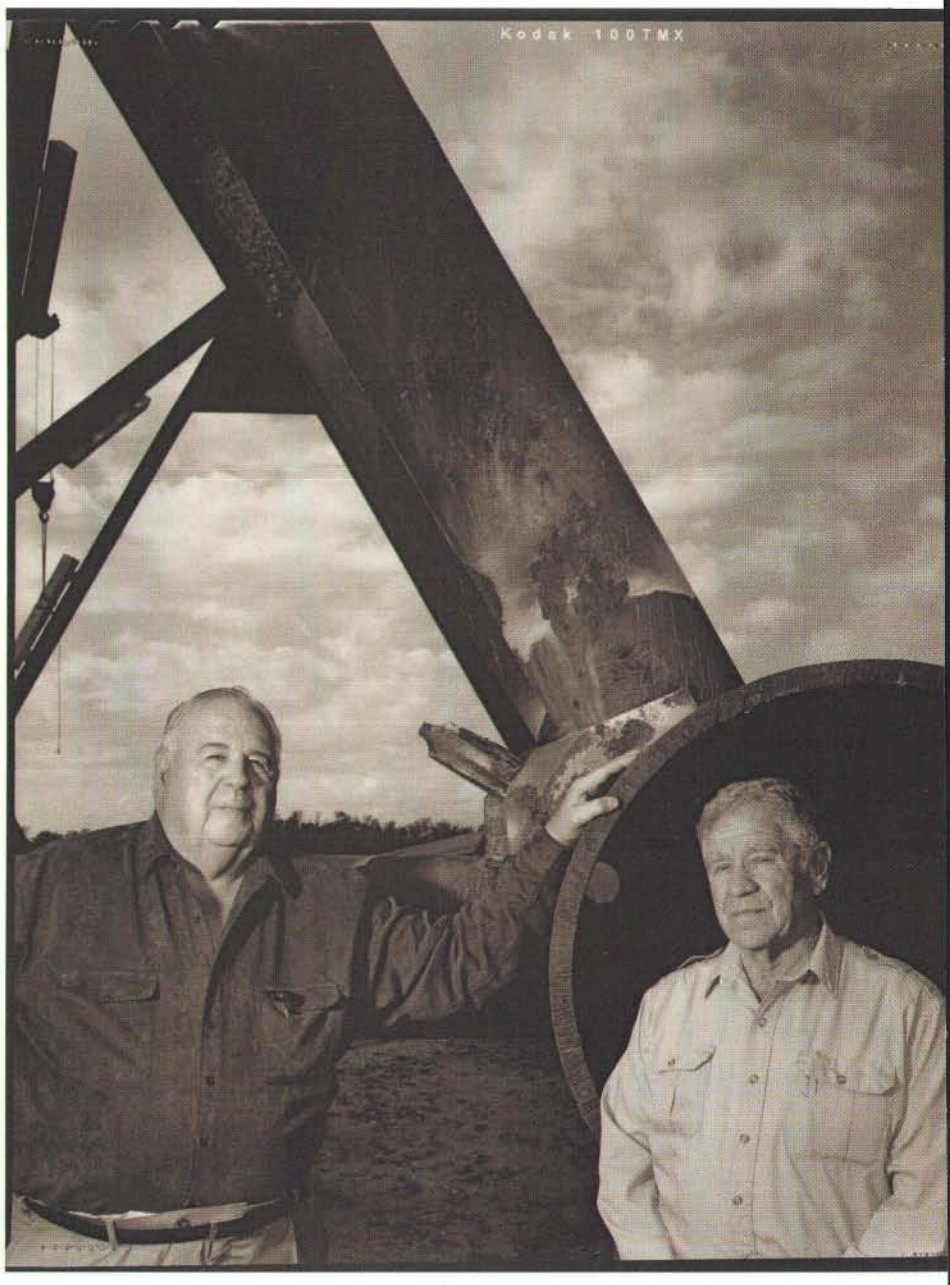
Platforms that have already seen more than a decade of service (left) will be topped with turbines and installed in the breezy waters off of Texas.

THE PORT OF IBERIA has never been busier. Situated on a narrow canal leading to the Louisiana coastline, the docks here throb with the sound of tugboats towing oil platforms to and from their anchorages in the Gulf of Mexico. When a drilling site is depleted, the platforms return to port; the docks are littered with rusting steel hulks waiting for their next run. ¶ In December, though, one of these platforms, stripped and refurbished by a local startup, returned to sea with a new mission. The first of a flotilla to come, it carried wind-monitoring equipment as well as radar for tracking migratory birds. Those that follow will be topped not by drilling rigs but by windmills. The turbines are bound for an 18-square-mile area roughly 10 miles off the coast of Galveston, Texas, where the first offshore wind farm in the US is under construction. That's right: The flower of sustainable energy is blooming in oil country. Get ready for the Great Texas Wind Rush.

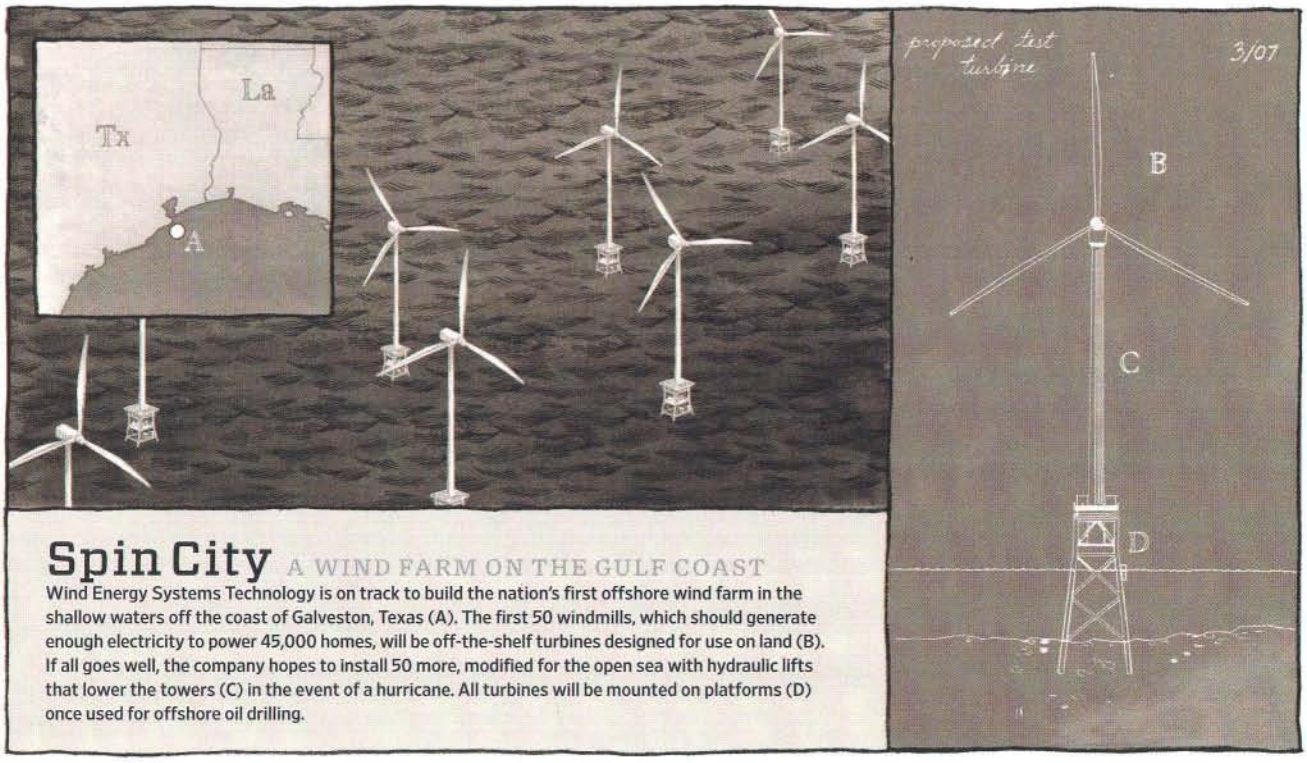
Formed in 2004, Wind Energy Systems Technology (WEST) is on track to commercialize offshore wind power well ahead of more established and better funded contenders with greener credentials. At $240 million and 150 megawatts of peak output—enough to power 45,000 homes—the project is modest. But the eyes of the alt-energy world are upon it. "WEST may not be in the mainstream, but they're definitely serious," says Walt Musial at the National Wind Technology Center in Colorado. "They might actually do it."

Wind energy is the most promising carbon-free, nonnuclear alternative to fossil-fueled grid power. But regions with enough space and breeze for land-based wind farms—mostly in the Midwest—are far from coastal population centers; the cost of running transmission lines between generators and users is a major disincentive. That's why wind-power entrepreneurs have set their sights on coastal waters. In the Atlantic, off Cape Cod, the 450-megawatt Cape Wind installation has been in the works for five years. But that project is mired in NIMBY activism and has yet to pass its initial federally mandated environmental review. (Ironically, a cabal of local property owners, including green-energy backers like US senator Edward Kennedy, are leading the fight against Cape Wind for fear it will mar the environment off Martha's Vineyard.) Another project proposed for New York's Long Island Sound has run into similar difficulties, and plans for wind farms off California have foundered on the expense of sinking pilings in the deeper Pacific coast waters.

Leave it to a couple of Gulf Coast good ol' boys to take up the slack.



Herman Schellstede, an oil platform designer, and Harold Schoeffler, a Sierra Club chapter chair, have launched a startup to provide clean power to the people of Texas.



Spin City A WIND FARM ON THE GULF COAST

Wind Energy Systems Technology is on track to build the nation's first offshore wind farm in the shallow waters off the coast of Galveston, Texas (A). The first 50 windmills, which should generate enough electricity to power 45,000 homes, will be off-the-shelf turbines designed for use on land (B). If all goes well, the company hopes to install 50 more, modified for the open sea with hydraulic lifts that lower the towers (C) in the event of a hurricane. All turbines will be mounted on platforms (D) once used for offshore oil drilling.

HAROLD SCHOEFFLER AND Herman Schellstede make an unlikely pair. Schoeffler, who owns a Cadillac dealership, is a Boy Scout troop leader and chair of the local Sierra Club chapter. Schellstede spent four decades designing oil platforms, drilling rigs, and pipelines. His most recent venture was a $45 million project for a Nigerian oil company. In contrast to New England, Schellstede says, in Louisiana "we have 60 years of offshore know-how."

The two men met in 1984, when they worked together on legislation to upgrade environmental standards for oil rigs. Two decades later, Schellstede was dismantling old oil platforms and barging them back to the Port of Iberia to be sold for pennies on the dollar when he read a Stanford University study that identified the Louisiana-Texas coastline as one of the best spots in the US for wind power. Average wind speed is exceptionally high, and it blows hardest during the hottest hours of the day, when demand for power is at its peak and electricity prices are highest.

Schellstede called Schoeffler, and they drew up a plan to bring offshore wind power to the oil patch. The key was to take advantage of existing oil-industry infrastructure. To save the expense of designing and building specialized offshore wind equipment, they would mount conventional windmills on decommissioned oil platforms. Hurricanes could be a problem, so they decided to outfit their windmills with hydraulic lifts scavenged from oil-industry machinery; the system would lower the turbines in the event of a squall. All told, the economics would enable WEST to compete with land-based wind power—in which Texas leads the nation—as well as with energy from increasingly pricey natural gas and newer coal plants that are still paying off construction costs.

But first they needed to secure government approval. Their first stop was the state of Louisiana, but the bayou bureaucrats rejected the proposal. "They saw us as competing with oil and natural gas," Schoeffler recalls.

So the pair turned to Jerry Patterson, commissioner of the Texas General Land Office, who had a reputation for supporting wind power. Patterson recognized that shallow-water petroleum reserves were running dry and that drilling in deeper water would be costly. So he set up a fast-track approval process in 2003 for alternative energy projects. Patterson offered to lease WEST the Galveston site for $10,000 a year, an order of magnitude less than the cost of comparable East Coast sites. In October 2005, WEST signed a contract to deliver 150 megawatts, which should take roughly 50 windmills. A test turbine is scheduled to be in operation this summer; the rest should be spinning by late 2008. Another 50 or so could follow by 2010 if demand warrants.

Meanwhile, Patterson's incentives are attracting other wind-power hopefuls to Texas. For example, Superior Renewable Energy, a company owned by an Australian investment firm, is angling to build a wind farm off Padre Island, near Corpus Christi, Texas. At 500 megawatts, that project is bigger than WEST's, but it won't be completed for several years.

WEST is taking full advantage of its head start, negotiating to sell energy to Galveston and to set up another wind farm for Utila, an island off the coast of Honduras. WEST's approach to offshore wind energy could finally allow clean power to compete economically with fossil fuels. If it shores up the Gulf Coast's obsolescent industrial infrastructure, with its unsightly barges and looming towers, all the better. Think of it as recycling on a grand scale.

JOHN GEOGHEGAN (johnjgeoghegan@yahoo.com) *is a writer in San Francisco.*

ILLUSTRATIONS BY **Joe McKendry**



The Invisible Enemy

CONTINUED FROM PAGE 139

were more often than not soaked with blood and other body fluids ... linen that covered the patients who were transferred back to Germany was not replaced." When hospital-grade disinfectants ran low, which was often, the supply crew stocked up on bleach from a local bazaar.

The derelict infrastructure of the Ibn Sina, where Jonathan Gadsden was treated during his evacuation, bedeviled the staff's best infection-control efforts. Rainwater dripped into operating rooms and supply closets, and pigeons roosted in the ventilation system, wafting the smell of droppings into the surgical suites. (A request was filed to the Iraqi Ministry of Health in September 2003 to "eliminate bird feces" from the air ducts.) Clean sheets and scrubs were scarce at the Ibn Sina as well, because the civilian laundry contractor was apparently selling them on the black market.

"When you're interested in immediate lifesaving, you can't be thinking about every infection-control nuance," says microbiologist Roberta Carey, branch chief of epidemiology at the CDC. "In any emergency room that deals with trauma patients, there's a limit—if they get too many patients from a car crash, they put the others on bypass and send them to another institution. But there is no bypass in a war zone."

The most effective way to curtail the development of multidrug-resistant bacteria is to limit the use of broad-spectrum antibiotics. But these drugs were dispensed widely in the CSHs. For wounded soldiers en route to Germany, they were employed as a kind of antimicrobial body armor to forestall future infection. But injured Iraqis would linger on antibiotic IV drips for weeks because the local medical facilities were overwhelmed or under rubble.

In the summer of 2003, civilian patients started getting sick at the Saarland University Hospital, one of the German facilities that admitted US troops evacuated from Iraq. A few months later, an elderly woman being treated for chronic lung disease at Landstuhl died suddenly of antibiotic-resistant acinetobacter pneumonia and bacteremia. DOD investigators found a perfect genetic match between the bug that caused her death and one infecting a military patient down the hall. Eventually, more than 30 civilian patients picked up acinetobacter infections at Walter Reed.

The bacteria was spreading beyond the theater of war.

Meanwhile, families of wounded US and British troops were being told—often in haphazard ways—that their loved ones were infected with an obscure organism they had somehow picked up in the desert.

A contractor named Merlin Clark was clearing mines near Baghdad for a company called Ronco Consulting when an IED took off the front of his left leg and severed a nerve in his right arm. When he first arrived at Walter Reed, his wife, Marcie, says, "they told us they had found bacteria, which you would expect from a dirty wound. We were more concerned that he might lose his leg."

Just before Marcie put her husband on a medevac to a hospital in Orlando, Florida, a nurse handed her a folder, which she put in her purse. "I went down to get Merlin's bags," Marcie recalls, "and the soldier who brought me to the van told me, 'Put everything in the laundry right away. Don't touch this stuff. Don't breathe around it. It's got that bug the guys are bringing back from Iraq.'"

She tossed the dusty clothes in a hotel washing machine and checked the folder, where she saw the words *Acinetobacter baumannii* for the first time. Frantic for more information about her husband's infection, she found little advice on sites for Iraq war veterans. "We felt so alone, having to figure out everything for ourselves," she says. (When PDHealth.mil, a Web site for doctors who treat vets, finally added an acinetobacter FAQ in 2005, it became one of the two most popular pages on the site.)

A veterans' activist named Kirt Love helped Marcie create a Web site to raise public awareness of the outbreak, which launched in 2004 at *www.acinetobacter.org*. Email started pouring in. "After speaking with other family members at Brooke, I discovered that almost all of their sons and daughters, husbands and wives, had tested positive," wrote the mother of one infected soldier. Another message read: "An apparently healthy civilian registered nurse working in the ICU at the National Naval Medical Center in Bethesda has a life-threatening acinetobacter infection ... Are other workers within the same environment equally at risk?"

As the bacteria spread through hospitals in the US and Europe, the DOD worked overtime to keep a lid on the rumors. In a PowerPoint presentation about acinetobacter and pneumonia delivered at the US Air Force School of Aerospace Medicine, a slide labeled "How to handle the press" read: "Don't lie. Don't obfuscate. Don't tell them any more than you absolutely have to."

Quietly, in spring 2004, a group of military doctors, infectious-disease specialists, and microbiologists decided to find out what was really going on with this bug. "My concern was that we were changing the bacterial environment in our hospitals, and I wasn't seeing a whole lot being done about it," says Tim Endy, the former communicable-disease research director at Walter Reed. "And now there were infections in patients who had never been to Iraq. The potential consequences to health care and to the cost of health care are huge."

The bills for imipenem use were soaring at Walter Reed, and each dose of the drug contributed to the snowballing resistance of the bacteria. Endy drafted a paper that became the catalyst for a full-fledged epidemiological consultation (an epicon, in military-speak) under the authority of the Army Surgeon General. Dozens of infectious-disease experts joined the investigation, along with academic researchers and epidemiologists from the CDC.

The task force sent field teams into Iraq and Kuwait to gather soil samples, swipe stretcher handles, and scour chow halls. When a storm dumped sand onto the decks of the *Comfort*, they swabbed the gunwale. To put the IED theory to the test, they took samples of bacteria from the dirty wounds of soldiers as they were admitted to the Ibn Sina. They also analyzed soil archived by the DOD before the war began.

The investigators did find acinetobacter in Iraq. It wasn't in the dirt—except for a few bugs under a dripping air conditioner outside a health care facility in Mosul—or in the fresh wounds, either. But multidrug-resistant *Acinetobacter baumannii* was thriv-

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ing in the emergency rooms, ICUs, and operating rooms of the combat support hospitals. As Paul Scott, one of the lead investigators, told a meeting of civilian epidemiologists in Chicago last spring, "This appeared to be a hospital-associated outbreak throughout our entire health care system."

The wounded soldiers were not smuggling bacteria from the desert into military hospitals after all. Instead, they were picking it up there. The evacuation chain itself had become the primary source of infection. By creating the most heroic and efficient means of saving lives in the history of warfare, the Pentagon had accidentally invented a machine for accelerating bacterial evolution and was airlifting the pathogens halfway around the world.

To stem the outbreak at its source, the epicon team proposed sweeping reforms throughout the combat zone. The CSHs had to be run more like real hospitals, with frequent scrub-downs, stringent handwashing, and HEPA filters to clean the air. The dead tissue surrounding "frag" wounds turned out to be an ideal colonization site for the bugs, so it had to be removed more aggressively up front. "If you don't have that necrotic tissue, your own innate defenses help keep the wound clean," says Kim Moran, a tropical-disease specialist who assisted the investigation when she worked at Walter Reed. Wound dressings needed to be changed less often, so bacteria from the hospital environment had less opportunity to get in. And the broad-spectrum antibiotics had to be reserved for the treatment of identified bugs.

At first, these reforms ran into a major obstacle: Each link in the evacuation chain was owned by a different branch of the DOD. "There was no coordination among the services about infection-control policy," Endy says. "No coordination about what kinds of antibiotics to use, no communication within the services about infectious disease problems. So it was almost impossible to coordinate any kind of broad policy changes." But then the task force phoned Donald Jenkins, a quick-thinking trauma surgeon at Balad who had already taken stock of the situation and tightened infection control in his own hospital. Jenkins briefed Elder Granger, head of the medical command throughout the region. "We basically tried to initiate a policy change from the bottom up, rather than the top down," Endy recalls. "And it worked."

Back in Washington, the DOD ramped up its medical surveillance networks to track the enemy as it moved instead of waiting for reports of full-blown infections. Epidemiological data across the armed services was logged in a central database for the first time. To pinpoint the particular strains causing the military infections, the investigators shipped more than 200 samples of acinetobacter to a biotech firm called Isis Pharmaceuticals, which has developed a new system for genetically fingerprinting unknown pathogens. For purposes of comparison, the Institut Pasteur in France also sent samples gathered during outbreaks in European hospitals years before the war.

"Lo and behold, most of the bacteria from the military hospitals were the same as the isolates from Europe—the same molecular signatures, the same patterns of antibiotic resistance," says Isis microbiologist David Ecker. "So my hypothesis became that there was a contamination of the US military health care system from organisms circulating in Europe, which happened somewhere along the path of the wounded soldiers."

The task force concluded that Camp Dogwood and Ibn Sina Hospital were likely the first links in the chain where the bugs took hold. At the epidemiologists' meeting in Chicago last spring, Paul Scott said that some of the medical equipment used at the two facilities was originally packed in Germany and may have been contaminated before it was shipped to Iraq. But the "index case" that set the whole process in motion may never be known.

It's not over. Acinetobacter is now a difficult part of daily life in many military hospitals, as it is in civilian ICUs and burn wards worldwide. And the rise of many other types of multidrug-resistant bacteria will make things even more difficult in the next few years, because there are few new antibiotics coming down the pipeline.

"The bugs are outpacing us, and these drugs are not the kind that bring in incredible profits," says Robert Guidos, director of public policy for the Infectious Diseases Society of America. "We're planning for bioterrorism and pandemic influenza, but what about the hundreds of thousands of people dying each year from nontheoretical situations? We need to think in longer terms."

One of the most unsettling long-term questions about the military outbreak is how far the bugs of war will proliferate now that thousands of Iraq veterans have entered the VA hospital system. Many of the older vets who are already there—struggling with chronic conditions for decades, in and out of nursing homes—fall into the bacteria's target demographic.

Duane Hospenthal of the DOD downplays the possibility that acinetobacter could become a problem in the wider population. "Mom comes to visit her son," he says, "and everybody's dressed up in gowns and gloves and hats and masks, and she wants to know, 'Is this something I'm going to drag home to my 4-year-old?' Those are the misconceptions I have to deal with from day to day. I can easily tell the family, 'No, this is something we do to keep it from passing from patient to patient. If you have it on your hands, it's not going to cause any disease.'"

Once acinetobacter makes itself at home in a health care facility, however, it's hard to get rid of and easy to pass along. Before Roberta Carey started working for the CDC, she spent months trying unsuccessfully to eradicate the bug from a university hospital in Illinois. "This organism requires many different assaults to get rid of," she says. "We see the bacteria metastasizing to neighboring institutions because medical personnel, students, families, and patients go back and forth into the community and to other medical centers. So we have to be vigilant."

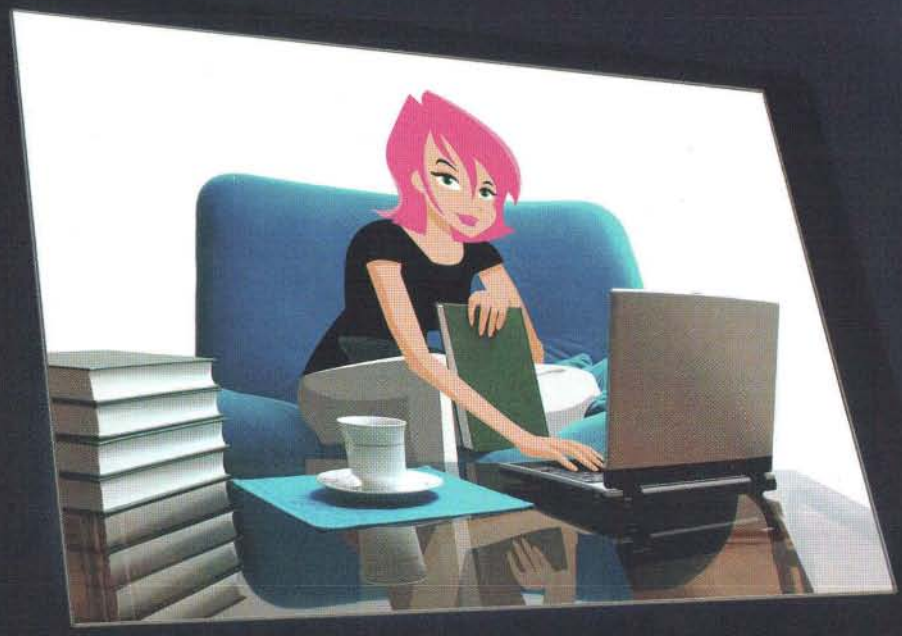
When a team of geneticists unlocked the secret of the bug's rapid evolution in 2005, they found that one strain of multidrug-resistant *Acinetobacter baumannii* carries the largest collection of genetic upgrades ever discovered in a single organism. Out of its 52 genes dedicated to defeating antibiotics, radiation, and other weapons of mass bacterial destruction, nearly all have been bootlegged from other bad bugs like *Salmonella*, *Pseudomonas*, and *Escherichia coli*.

In the open source world of bacteria, everyone is working for the resistance. Ramping up the immunity of any single organism, while dramatically increasing the size of the population most susceptible to infection, only helps the enemy. To an aspiring superbug, war is anything but hell.

Contributing editor **STEVE SILBERMAN** (digaman@wiredmag.com) *wrote about Darren Aronofsky in issue 14.11.*

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A Second Life for MTV

CONTINUED FROM PAGE 143

air on a hoverboard—one of which nearly takes my virtual head off as I talk to an avatar named Luvley.

Luvley's virtual life sounds as good as any on TV. A smiling, ponytailed brunette in a jeans skirt and fuchsia halter top, she was voted VLB prom queen in November. Cliques and social success are quantifiable in this world: A quick check of Luvley's profile shows that though she has been in-world for only three months, she has already been added to the "buddy list" of no fewer than 715 VLB members. A member of more than 20 clubs with names like Any_Party_Any_Time and The_Hot_Girls_and_Guys_of_VLB, she has also made impressive progress up various status levels, achieving a favorable ranking in categories like Fashionista and Socializer.

"Luvley is me. I don't change my character," says Mari Castillo, the 23-year-old Chicago nursing student behind the avatar. But her character may be changing her. Luvley recently got virtually engaged to an avatar named BrodyJ, who is Castillo's "best guy friend" in the physical world. The pair has known each other for more than nine years, but they've never been romantically involved. With BrodyJ's creator away at college, they stay in touch through VLB. "It was always a friendship thing, but now I think this whole virtual hookup is making him notice me," Castillo says. "When he gets back home, who knows? We might hook up."

This kind of seamless integration with the real world is exactly what MTV wants Virtual Laguna Beach to be all about. But like YouTube and MySpace, MTV still needs to find a way to make the virtual world pay. User participation and brand building aren't enough. Jeff Yapp, an MTV executive vice president who leads the Leapfrog unit, thinks that VLB has the potential to generate bigger bank per person than the TV show from which it sprang.

"If you look at our monetization on a viewer basis for *Laguna Beach*, we're making pennies a person," Yapp says. But, he says, visitors to Virtual Laguna Beach might buy a DVD of the show, a branded T-shirt, or a virtual T-shirt for their avatar (in-world currency can be purchased with a credit card at an exchange rate of 180 MTV bucks to the US dollar). And hardcore fans will be able to get virtual crash pads and flirt via VoIP when MTV launches a $6-per-month premium service.

MTV may never match revenue from TV commercials by becoming a virtual landlord. But the opportunity for advertisers is another story. In VLB, products can be integrated into the virtual experience. Instant-messaging windows can be skinned as Cingular cell phones, virtual Pepsi cans are a surprisingly popular accoutrement, and Secret deodorant recently ran a contest in which VLB members confess a secret—the best secrets got turned into video clips that were screened for virtual audiences at the Laguna Cinema and other locales in VLB.

Advertisers can't help but love an online space in which the hard-to-reach demographic of teenage girls makes up around 55 percent of members (which explains why a guy who signs into VLB is usually mobbed with potential admirers). About 40 percent of all members are under 17. On average, users visit six times a month for 35 minutes a session. (The typical Web site devoted to a television show receives just five six-minute visits per user per month.) And sign-ups have continued to rise since the end of the *Laguna Beach* season in November. Yapp talks about the network's ability to push a "fire hose" of viewers toward the service. "The real challenge is sustaining the community over time," Bostwick says.

He's right about that. According to Jeffrey Cole, director of the Center for the Digital Future at the University of Southern California, kids are just as fickle online as off. "To teenagers, online communities are like nightclubs," Cole says. "When the uncool kids start showing up, you're out of there."

Luvley is preparing for her in-world wedding. Her best friend, Kelee, threw her an engagement party, and more than 100 avatars showed up. Invites went out asking guests not to upstage the happy couple by wearing similar outfits. Luvley and BrodyJ also mailed out a screenshot of themselves seated in front of a glowing orange sunset, the scene of the couple's first virtual kiss. Online romances like this may be the future of reality programming. Take the breakup of avatars LittleDebbie and BradForYou—their tale was scripted and filmed in VLB and then broadcast on MTV last November.

This is what Bostwick calls a "brand-new kind of media," a fully symbiotic relationship between the small screen and the computer screen, between the network, its audience, and its advertisers. It's not just that MTV wants to get its viewers pushing virtual-world content back out to television. In the Leapfrog model, the virtual world becomes an equal partner. Your experience there isn't secondary to a TV show or video rotation; it is the show, and it is the rotation.

This year, the Leapfrog team will roll out a "music world," a new 3-D social space that replicates hip clubs in Brooklyn and Manhattan's Lower East Side. "Your social status in this world might be based on how early you discover new bands and share them with others," Yapp says. Do well enough and you can become a virtual promoter, programming music at in-world clubs. Up-and-coming bands will also be able to do virtual gigs in-world, and Yapp suggests that exposure in the CG realm could eventually land them a spot on MTV. That's a lot better than hoping an A&R guy finds your song on MySpace.

"I can't wait to launch more worlds around different shows," Toffler says. Tom Dooley, senior executive vice president of Viacom, says the money is committed to roll out these branded 3-D realms. "Sumner [Redstone, Viacom's founder] is fascinated by the virtual currency and the way this world is interfacing with the real world," says Dooley.

Explorable 3-D versions of MTV's shows may not be enough to give the network the cultural cachet it had in the Reagan era. But the trend is clear: Kids will do more and more of their networking and socializing in 3-D spaces like VLB and There.com.

"All you could do on MySpace is leave comments and emails," says Luvley. "This is the virtual world. You can walk, talk, play games, meet people instead of searching for them. Like any other community, you have cliques, people you trust, people you dislike. It's pretty much the same as real life, I would say."

MARK WALLACE (themetaverse @gmail.com) *writes about virtual worlds at 3pointD.com. He contributed to the Second Life travel guide in issue 14.10.*

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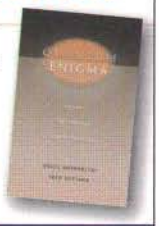




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